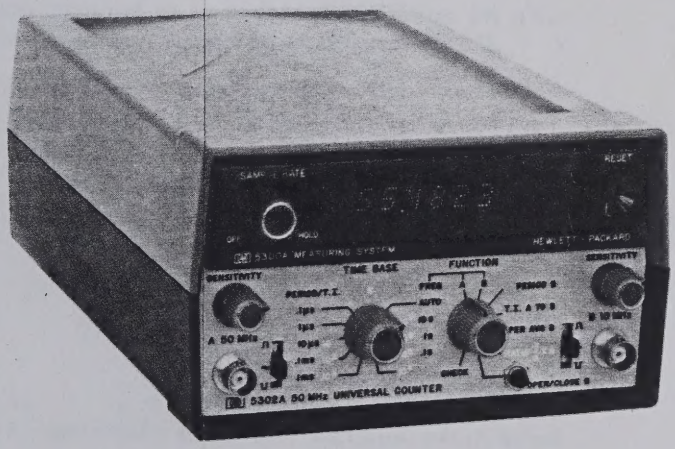
OPERATING AND SERVICE MANUAL

UNIVERSAL COUNTER

5302A



HEWLETT hp PACKARD

SECTION IX B
UNIVERSAL COUNTER
5302A

SERIAL PREFIX 1444A

This Section applies directly to HP Model 5302A, Universal Counters having serial prefix number 1444A, and must be inserted into the 5300A Measuring System Manual.

NEWER INSTRUMENTS

This Section with enclosed "Manual Changes Sheets" applies directly to HP Model 5302A Universal Counters having prefix numbers above 1444A.

OLDER INSTRUMENTS

Changes required to back-date this Section for older instruments are in Section IX B, Subsection VII.

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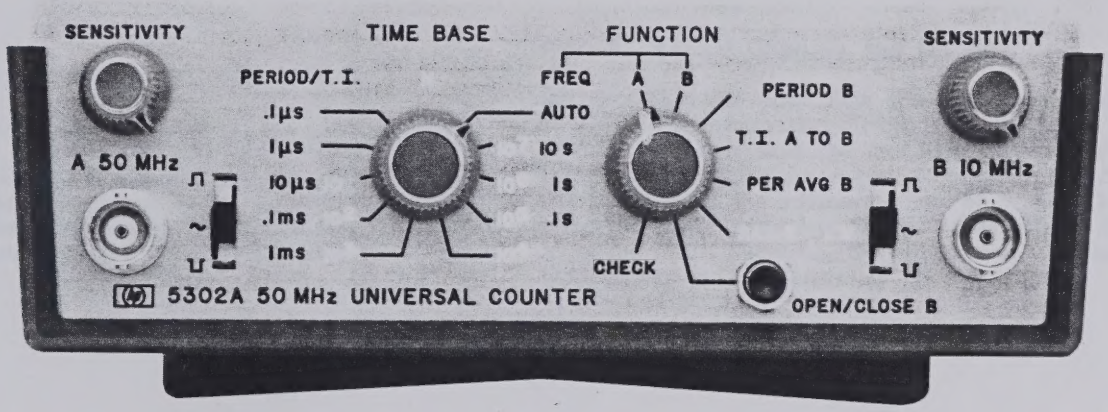
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Figure 9B-1-1. Model 5302A Universal Counter



SECTION IX B
5302A UNIVERSAL COUNTER
SUBSECTION I
GENERAL INFORMATION

9B-1-1. INTRODUCTION

9B-1-2. Description

9B-1-3. The Hewlett-Packard Model 5302A Universal Counter, when plugged onto an HP Model 5300A Measuring System, is capable of: Measuring frequencies up to 50 MHz, Time Interval measurements from 500 nsecs to 1000 seconds, Period and Period Average over a range of 10 Hz to 1 MHz, Ratio of two Frequencies and Totalizing. The electrical and mechanical specifications are listed in Table 9B-1-1.

9B-1-4. Purpose and Use of Section IX B

9B-1-5. Section IX B contains the documentation necessary to operate, maintain, and repair the HP Model 5302A Universal Counter plug-on. Also included are parts lists, component locators, and schematics. This information is intended to be inserted into the 5300A Measuring System manual as part of Section IX of that manual.

9B-1-6. INSTRUMENT IDENTIFICATION

9B-1-7. Hewlett-Packard uses a two-section, nine-digit serial number (0000A00000) mounted on the rear panel to identify the instrument. The first four digits are the serial prefix and the last five digits refer to the specific instrument. If the serial prefix on your instrument differs from that listed on the title page of this section, there are differences between the manual and your instrument. Lower serial prefixes are documented in Section IX B, Subsection VII and higher serial prefixes are covered by a manual change sheet included with the manual.

9B-1-8. Manual Changes and Options

9B-1-9. The title page lists the serial prefix number to which this information directly applies. If the serial prefix is different from the one listed, a change sheet is included describing the required changes. If this change sheet is missing, the information can be supplied by any Hewlett-Packard Sales and Service office listed in Section VI of the 5300A Measuring System manual. Options are listed in Section IX B, Subsection VII.

Table 9B-1-1. 5302A Universal Counter Specifications

INPUT CHANNELS A AND B

RANGE: Channel A: 10 Hz to 50 MHz.
Channel B: 10 Hz to 10 MHz.

SENSITIVITY (min): 25 mV rms sine wave 50 Hz to to 1 MHz.
50 mV rms sine wave 10 Hz to 10 MHz.
100 mV rms sine wave at 50 MHz.
150 mV p-p pulse at 50 nsec minimum pulse width.
Sensitivity can be varied up to 2.5 V rms by adjusting the SENSITIVITY control.

IMPEDANCE: 1 MΩ shunted by less than 30 pF.

OVERLOAD PROTECTION: 500 V (dc + peak ac)
250 V rms, dc to 400 Hz.
10 V rms above 10 MHz.

TRIGGER LEVEL: Selectable positive, negative, or zero V for optimum triggering from sinusoidal inputs or pulses.

SLOPE: Automatically switched to trigger on leading edge of pulse. Positive slope for sinusoidal inputs.

GATE OUT: Rear panel BNC. TTL low level while gate is open.

FREQUENCY

RANGE: Channel A: 10 Hz to 50 MHz. Prescaled by 10.
Channel B: 10 Hz to 10 MHz.

GATES TIMES: Manually selected 0.1, 1 or 10 seconds. AUTO position automatically selects gate time to fill display for maximum resolution within 1-second measurement time.

ACCURACY: ±1 count ± time base accuracy.

DISPLAY: Hz, kHz, and MHz with positioned decimal point.

TIME INTERVAL

RANGE: 500 nsec to 1000 seconds.

INPUT: Channels A and B.

RESOLUTION: 100 nsec to 1 msec in decade steps.

ACCURACY: ±1 count ± time base accuracy ± trigger error. *

DISPLAY: μs, ms, or S (seconds) with positioned decimal point.

PERIOD

RANGE: 10 Hz to 1 MHz.

INPUT: Channel B.

RESOLUTION: 100 nsec to 1 msec in decade steps.

ACCURACY: ±1 count ± time base accuracy ± trigger error. **

DISPLAY: μs, ms, or S (seconds) with positioned decimal point.

PERIOD AVERAGE

RANGE: 10 Hz to 1 MHz.

INPUT: Channel B.

PERIODS AVERAGE: 1 to 10^3 automatically selected for maximum resolution.

RATIO

DISPLAY: F_B/F_A times multiplier (N).

N = 10 to 10^7, selectable in decade steps.

RANGE: Channel A: 10 Hz to 1.0 MHz.
Channel B: 10 Hz to 10 MHz.

ACCURACY: ±1 count of F_B ± trigger error of F_A. *

OPEN/CLOSE (Totalizing)

RANGE: 10 MHz maximum.

INPUT: Channel B.

FUNCTION: Input signal totalized while gate is open. Opening and closing of gate initiated by front panel pushbutton switch.

GENERAL

CHECK: Counts internal 10 MHz reference frequency.

OPERATING TEMPERATURE: 0° to 50°C.

POWER REQUIREMENTS: Including 5300A mainframe, nominally 10 watts.

WEIGHT: Net, 2 lbs. (0.9 kg). Shipping, 3 to 14 lbs. (1.5 kg).

*For any waveshape, trigger error is less than

$$\pm \frac{0.0025}{\text{Signal Slope } (V/\mu s)\ \mu s}$$

**Trigger error is less than ±0.3% of one period periods average for signals with 40 dB or better signal-to-noise ratio and minimum amplitude. Decreases with increased signal amplitude and slope.

SECTION IX B
5302A UNIVERSAL COUNTER
SUBSECTION II
INSTALLATION

9B-2-1. UNPACKING AND INSPECTION

9B-2-2. If the shipping carton is damaged ask that the carrier's agent be present when the instrument is unpacked. Inspect the instruments for damage such as scratches, dents, broken knobs, etc. If the instrument is damaged or fails to meet performance tests when used with the 5300A Measuring System notify the carrier and the nearest Hewlett-Packard Sales and Service office immediately. Performance check procedures are located in Section IX, B-5, and Sales and Service offices are listed in Section VI of the 5300A portion of the manual. Retain the shipping carton and the padding material for the carrier's inspection. The Sales and Service office will arrange for the repair or replacement of the instrument without waiting for the claim against the carrier to be settled.

9B-2-3. STORAGE AND SHIPMENT

9B-2-4. PACKAGING. To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your Hewlett-Packard Sales and Service office can provide packaging material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here is one recommended packaging method:

a. The original container is a corrugated cardboard box with 200 lbs. burst test (HP No. 9211-1620). The instrument is secured and protected, while in the box by a top and bottom molded frame of polystyrene foam (HP No. 9220-1545). Also included with the instrument is a plastic dust-protection cover HP Part No. 05300-80004.

9B-2-5. INSTALLATION AND REMOVAL OF PLUG-ON

9B-2-6. The 5302A Universal Counter must be used with a mating 5300A Measuring System before any measurements can be made. To mate the 5302A Universal Counter with the 5300A Measuring System, see Figure 2-1 and Paragraph 2-11 of the 5300A portion of the manual.

9B-2-7. ENVIRONMENT. Conditions during storage and shipment should be normally limited as follows:

a. Maximum altitude: 25,000 feet.

b. Minimum temperature: -40°F (-40°C).

c. Maximum temperature: +167°F (+75°C).

9B-2-8. PORTABLE OPERATION

9B-2-9. The use of the HP Model 5310A Battery Pack enables the 5300A Measuring System and 5302A Universal Counter to be used in areas removed from ac power sources. The 5310A Battery Pack typically provides five hours of portable operating time before recharging. Tables 1-2 and 1-4 of 5300A portion of the manual lists the HP 5310A Battery Pack as an available accessory. Documentation on the 5310A is also included in Sections IV through VIII of the 5300A portion of the manual. To prepare the 5300A/5302A for portable operation, refer to Paragraph 2-15 and Figure 2-2 steps a to c of 5300A portion of manual.

SECTION IX B
5302A UNIVERSAL COUNTER
SUBSECTION III
OPERATION

9B-3-1. OPERATING INFORMATION

9B-3-2. The 5302A Universal Counter Plug-on may be used to measure frequencies up to 50 MHz, Period and Period Average to 1 MHz, Time Interval from 500 nsec to 1000 seconds or Ratio measurements from 10 Hz to 10 MHz. The instrument may also be used to Totalize input signals.

9B-3-3. The instrument front panel contains several controls and connectors used to make measurements with Channel A or Channel B or are used to control both channels. Some of these controls are used in signal conditioning to enable the user to take advantage of the instrument's built-in precision.

9B-3-4. There are three basic signal conditioning controls used in both Channel A and/or Channel B. There are:

a. Sensitivity controls for Channel A and B.

b. Waveform controls for Channel A and B.

c. TIME BASE control for Channel A and B.

9B-3-5. SENSITIVITY CONTROLS (Both Channels). A typical signal may contain large harmonics or noise, which can introduce inaccuracies in the reading. These sources of error may be minimized by correct use of the various signal conditioning controls.

9B-3-6. The input amplifiers and trigger circuits of both channels include a "dead band" or hysteresis. In order to trigger the counter, the input signal must pass completely through this "dead band". Any noise or unwanted signal, cannot cause a false trigger unless the amplitude of the noise is greater than the "dead band". The SENSITIVITY control adjusts the width of the dead band so that it is small enough to trigger on the signal but large enough to reject noise and harmonics (as shown in Figure 9B-3-1).

9B-3-7. To set the SENSITIVITY control for the best reading, set the control full ccw and increase the SENSITIVITY (cw) until stable triggering occurs. Increase the SENSITIVITY a fraction more to allow for amplitude variations in the signals. If the signal contains large amplitude modulation, the sensitivity must be adjusted to trigger on all cycles of the carrier frequency. In this case, it may be preferable to begin with the highest sensitivity setting (full cw) then decrease the sensitivity (ccw) to reject any noise until the display is stable. The sensitivity setting is more easily adjusted with a fast gate time such as .1-second. Gate time may be increased for finer resolution.

9B-3-8. WAVEFORM CONTROLS (Both Channels). This switch is normally used in the " ∿ " position and for most signals including sine wave, square wave, sawtooth wave, and pulses which have an approximate 50% duty-cycle. The hysteresis dead band in this position is centered on the average value of the signal. Since the amplifier is ac coupled, a dc offset in the signal does not effect triggering.

9B-3-9. The two pulse positions on the waveforms switch should be used only with positive or negative pulses where the pulse width is short compared to the spacing between pulses. In this case, the average value of the signal is close to the baseline of the pulse which is not the optimum point to trigger the counter. In the positive pulse position, the dead band is offset to respond only to the positive segment of the pulse above the average value. In the negative pulse position, the dead band is offset to respond to the negative part of the signal. In either case, the effect of the SENSITIVITY control is to move the center of the dead band, as well as its width, so that the trigger circuits still respond only to the positive part or the negative part of the signal as shown in Figure 9B-3-1.

9B-3-10. TIME BASE CONTROL. The TIME BASE control switch provides four gate time positions (black) and seven multiplier settings (N white) for Ratio mode. It also provides decade-step resolution settings from .1 μsec to 1 ms (blue) for Period or Time Interval measurements. These various positions are selectable for Channel A and/or B through the FUNCTION switch. These are:

a. AUTO. This is the most useful setting for measuring an unknown frequency. It will automatically select a gate time of:

1-second for frequencies up to 900 kHz when using Channel B and up to 9 MHz when using Channel A.

0.1-second for frequencies between 900 kHz and 9 MHz when using Channel B and 9 MHz to 50 MHz when using Channel A.

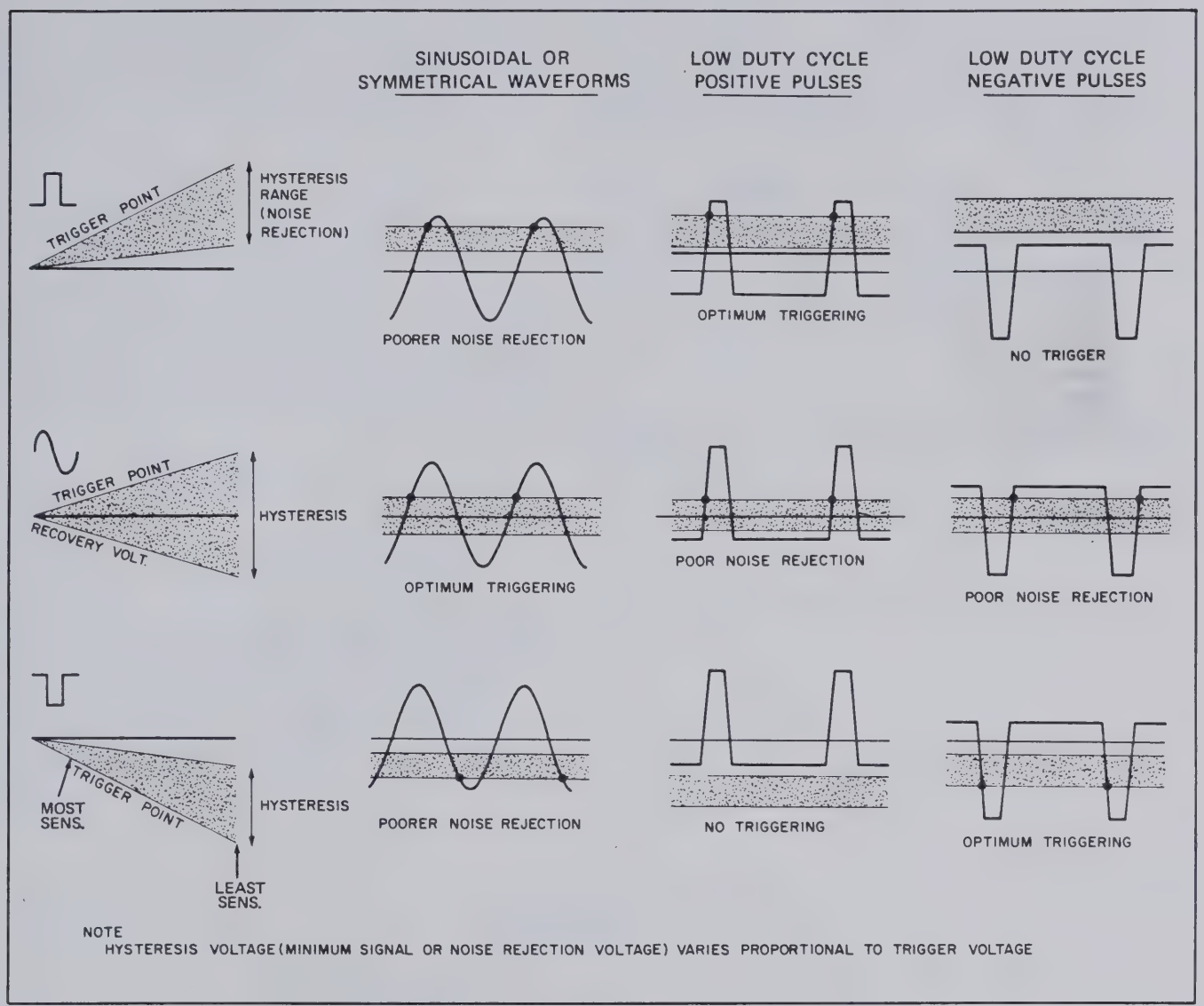
The display will never overflow in the AUTO position. The recycle time is held constant at 1-second plus the sample rate time for all frequencies.

b. 0.1 SEC. This position provides the fastest recycle time with a constant 10 Hz resolution when using Channel B and 100 Hz resolution when using Channel A. It is most useful for monitoring fast changes in the input frequency and for setting the signal conditioning controls.

c. 1 SEC. Provides constant 1 Hz resolution when using Channel B and 10 Hz resolution when using Channel A. Since the recycle time is the same as in AUTO this position offers an advantage only for measuring signals above 900 kHz with a 1 Hz resolution. Display will overflow above 1 MHz.

d. 10 SEC. Provides 0.1 Hz resolution in Channel B and 1 Hz resolution in Channel A. This setting is not available in AUTO and must be selected manually if the extra precision is required.

Figure 9B-3-1. Signal Conditioning by Waveform Switch and Sensitivity Control



e. N (white). Provides decade-step multiplier settings when FUNCTION switch is set to RATIO.

f. PERIOD/T.I. (blue). Decade step resolution settings may be selected when using Period B or T.I. A to B modes.

9B-3-11. MODES OF OPERATION

9B-3-12. The 5302A offers seven modes of operation and a Self-Check position. Some of the modes are available on both channels while other modes are available only on one channel (either A or B). In all cases, the modes are selected by the FUNCTION switch. The modes are:

a. Frequency (Channel A or B).

b. Period (Channel B only).

c. Time Interval (Channel A to B).

d. Period Average (Channel B only).

e. Ratio, $\frac{B}{A}$ X N (Channel A and B)

f. Totalize, OPEN/CLOSE B (Channel B only).

g. Check Mode.

9B-3-13. Frequency Mode, Channel A

9B-3-14. Frequency measurements using Channel A enables the user to make frequency measurements from 10 Hz to 50 MHz. When using Channel A the input signal is prescaled by 10.

9B-3-15. Frequency Mode, Channel B

9B-3-16. Frequency measurements using Channel B enables the user to make frequency measurements from 10 Hz to 10 MHz. Since no prescaling occurs, higher resolution measurements can be made using Channel B.

9B-3-17. Period Mode, Channel B

9B-3-18. The period mode allows single period measurements to be made with frequencies of 10 Hz to 1 MHz into Channel B. In Period B measurements the Time Base gate time is selectable from .5 μsec to 1 msec. The accuracy is ± 1 count ± time base accuracy ± trigger error.

9B-3-19. Time Interval Mode, Channel A to B

9B-3-20. The time interval mode allows time measurements, between points on one or two waveforms, to be made. The range of measurements is .1 μsec to 1000 seconds with .1 μsec to 1 msec resolution in decade steps. Channel A input signal opens the main gate and Channel B closes it. An output is available at the rear of the unit during the time the main gate is open. Accuracy is ± 1 count ± time base accuracy ± trigger error. The trigger error for any waveshape is less than

$$\pm \frac{0.005}{\text{Signal Slope (V/}\mu\text{s)}\,\mu\text{s}}$$

9B-3-21. Period Average Mode, Channel B

9B-3-22. The period average mode allows multiple period averages to be made with frequencies of 10 Hz to 1 MHz into Channel B. Periods averaged is automatically selected from 1 to 10^3 for maximum resolution. For frequencies less than 110 Hz, one period is measured; for frequencies from 110 Hz to 1100 Hz, ten periods are averaged; for frequencies from 1100 Hz to 11 kHz, 100 periods are averaged; for frequencies above 11 kHz, 1000 periods are averaged.

9B-3-23. Ratio Mode, Channel B/A

9B-3-24. The ratio of the Channel B input signals (from 10 Hz to 10 MHz) to the Channel A input signals (from 10 Hz to 1 MHz) times multiplier N, can be measured. Multiplier is selectable from 10 to 10^7. Accuracy is ± 1 count of Frequency B, ± trigger error of Frequency A.

9B-3-25. Totalizing Mode, Channel B

9B-3-26. Input Signals up to 10 MHz, applied to Channel B can be totalized. Totalizing is initiated by pressing the OPEN/CLOSE B switch and terminated by pressing the OPEN/CLOSE B switch a second time.

9B-3-27. CHECK Mode

9B-3-28. The Check mode provides a position where the instrument 10 MHz oscillator and counting logic is verified. The 5300A displays 10.0000 MHz ± 1 count when circuits are functioning properly.

9B-3-29. CONTROLS AND CONNECTORS

9B-3-30. Figures 9B-3-2 and 9B-3 3 list the various front panel controls and connectors and the rear panel connector.

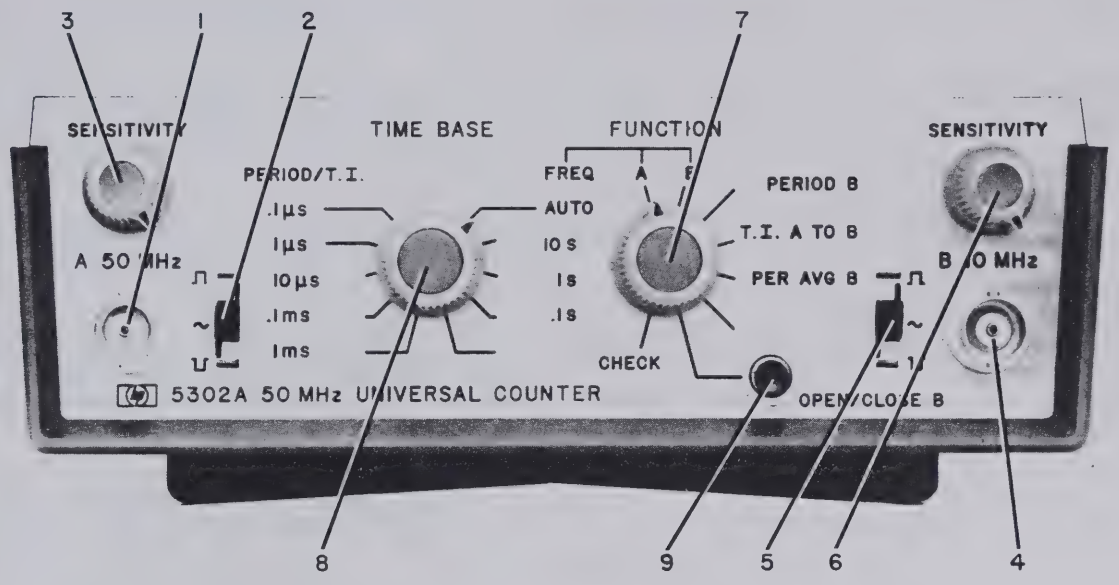
9B-3-31. OPERATING PROCEDURES

9B-3-32. The operating procedures for making measurements in the various modes are listed in Figures 9B-3-4 through 9B-3-10.

WARNING

TO AVOID POSSIBILITY OF BODILY INJURY AND/OR EQUIPMENT DAMAGE WHILE PERFORMING THE FOLLOWING PROCEDURE, BE SURE TO OBSERVE POLARITY REQUIREMENTS WHEN CONNECTING TEST LEADS. (HEWLETT-PACKARD RECOMMENDS USING AN ISOLATION TRANSFORMER WHEN MEASURING AC LINE FREQUENCIES.) ADDITIONALLY, DO NOT EXCEED THE INPUT VOLTAGE LIMITATIONS AS SPECIFIED IN TABLE 9B-1-1.

Figure 9B-3-2. Front Panel Controls and Connectors



CHANNEL A

Grouped on left side of panel

1. "A 50 MHz" connector. Input signals from 10 Hz to 50 MHz can be measured using this connector. Input signal is prescaled by 10.

2. Waveform Switch. Set to correspond to one of three types of input signals. (See Paragraph 9B-3-8 for correct adjustment.)

 a. ⎍ : Input signals to be measured is positive-going pulse of low duty-cycle.

 b. ∿ : Input signal to be measured is sinusoidal or is another type of signal with about a 50% duty-cycle.

 c. ⎎ : Input signal to be measured is negative-going pulse of low duty-cycle.

3. SENSITIVITY. Potentiometer adjusts counter channel A sensitivity; maximum sensitivity is at full cw.

CHANNEL B

Grouped on right side of panel

4. "B 10 MHz" connector. Input signals from 10 Hz to 10 MHz can be measured using this connector.

5. Waveform switch. Set to correspond to one of three types of input signals. (See Paragraph 9B-3-8 for correct adjustment.)

 a. ⎍ : Input signals to be measured is positive-going pulse of low duty-cycle.

 b. ∿ : Input signal to be measured is sinusoidal or is another type of signal with about a 50% duty-cycle.

 c. ⎎ : Input signal to be measured is negative-going pulse of low duty-cycle.

6. SENSITIVITY. Potentiometer adjusts counter Channel B sensitivity; maximum sensitivity is at full cw.

Figure 9B-3-2. Front Panel Controls and Connectors (Continued)

7. FUNCTION. Eight position switch used to select the desired mode of operation. The positions are:

a. FREQ A. Enables frequency measurements of 10 Hz to 50 MHz to be made using Channel A connector and signal conditioning controls.

b. FREQ B. Enables frequency measurements of 10 Hz to 10 MHz to be made using Channel B connector and signal conditioning controls.

c. PERIOD B. Enables single period measurements to be made from Channel B with frequencies of 10 Hz to 1 MHz.

d. T.I. A to B. Enables time interval measurements to be made between signals into Channel A and signals into Channel B. Channel A starts measurements, Channel B stops it.

e. PER AVG B. Enables multiple period averages to be made from Channel B with frequencies of 10 Hz to 1 MHz. Periods averaged is a automatically selected from 1 to 10^3.

f. RATIO $\frac{B}{A}$ X N. Enables the ratio of Channel B signals to Channel A signals to be taken. Channel A input is 10 Hz to 1 MHz and Channel B input is 10 Hz to 10 MHz. Multiplier (N) is selectable from 10 to 10^7.

g. OPEN/CLOSE B. Enables input signals to Channel B (10 Hz to 10 MHz) to be totalized. Totalizing is initiated by pressing the OPEN/CLOSE B switch and terminated by pressing this switch a second time. Restarted by pressing the switch a third time.

h. CHECK. Self-Check position verifies that the 5300A 10 MHz crystal oscillator and the counting logic is functioning correctly.

8. TIME BASE. This 10-position switch performs three functions:

a. Gate time controls for frequency measurements.

b. Period/Time Interval resolution control.

c. Ratio Multiplier control for ratio measurements.

FREQ. (black) Gate time positions are:

a. AUTO. Automatically selects the measurement gate time needed to fill the display for maximum resolution for the signal being measured with a maximum time of 1 second.

b. 10S, 1S, .1S. Counter gate time is 10 seconds, 1-second, or .1-second corresponding to the switch position.

PERIOD/T.I. (blue) positions are:

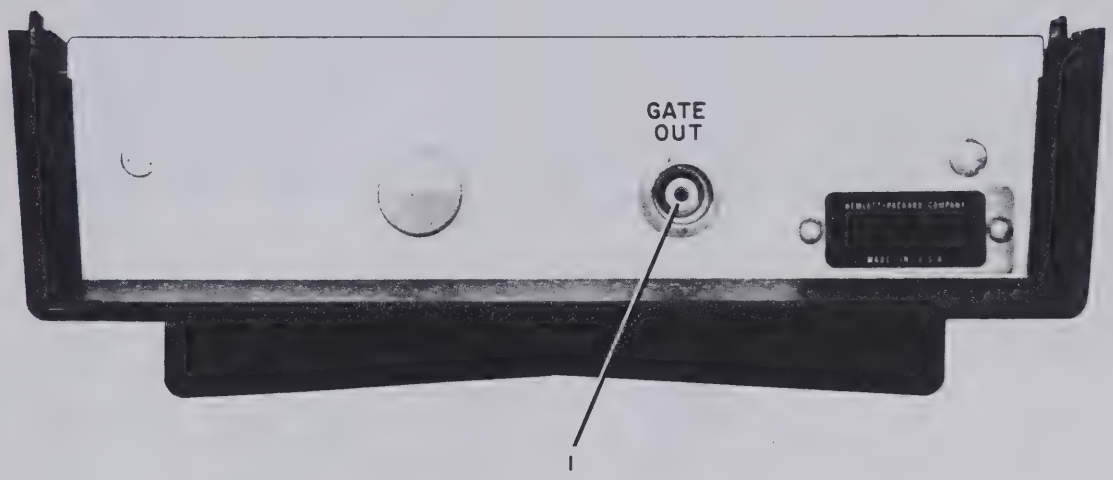
.1 μs, 1 μs, 1 ms, 1 ms. In Period measurements and Time Interval measurements, the resolution of the measurement is adjustable from .1 μsec to 1 msec in decade steps.

"N" Multiplier (white) positions are:

10, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7. In Ratio mode the multiplier is selectable, in decade steps, from 10 to 10^7.

9. OPEN/CLOSE B Pushbutton switch, effective in indicated position of FUNCTION switch. Totalizing of Channel B input signals started by pressing this switch and terminated by pressing it a second time. Restarted by pressing the switch a third time.

Figure 9B-3-3. Rear Panel Connector

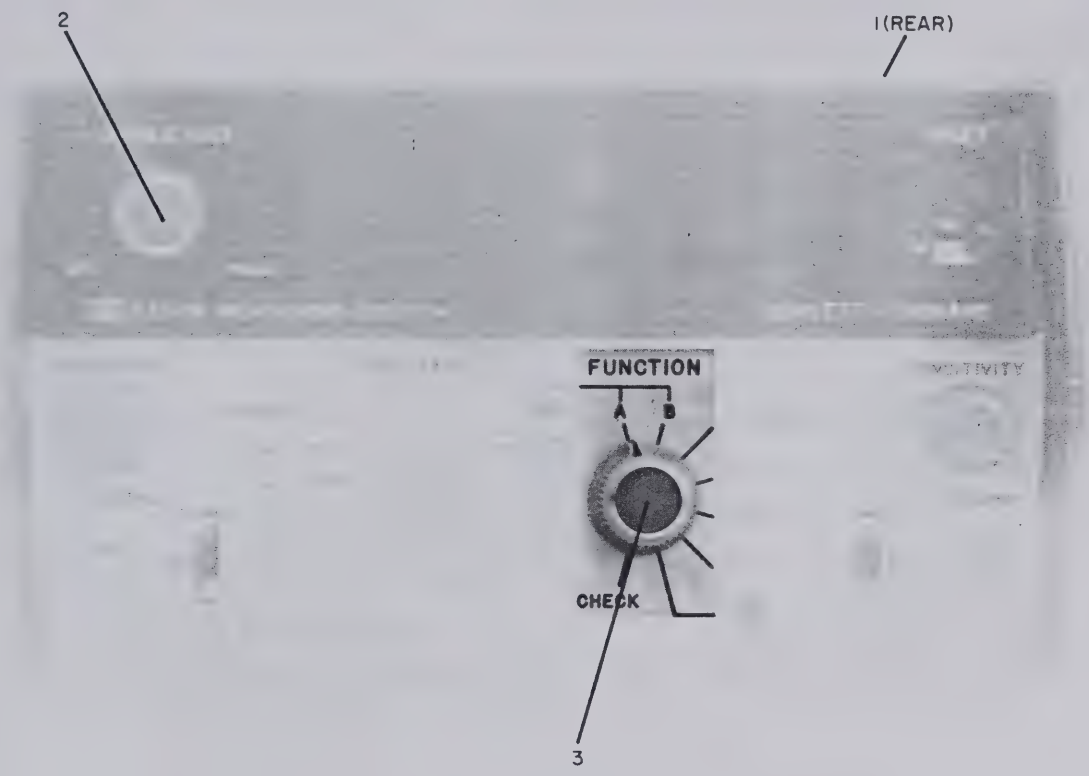


1. GATE OUT: A TTL-LOW level is available while the instrument gate is open.

Caution

DO NOT CONNECT EXTERNAL VOLTAGES TO GATE-OUT CONNECTOR.

Figure 9B-3-4. Making Self-Check Measurements

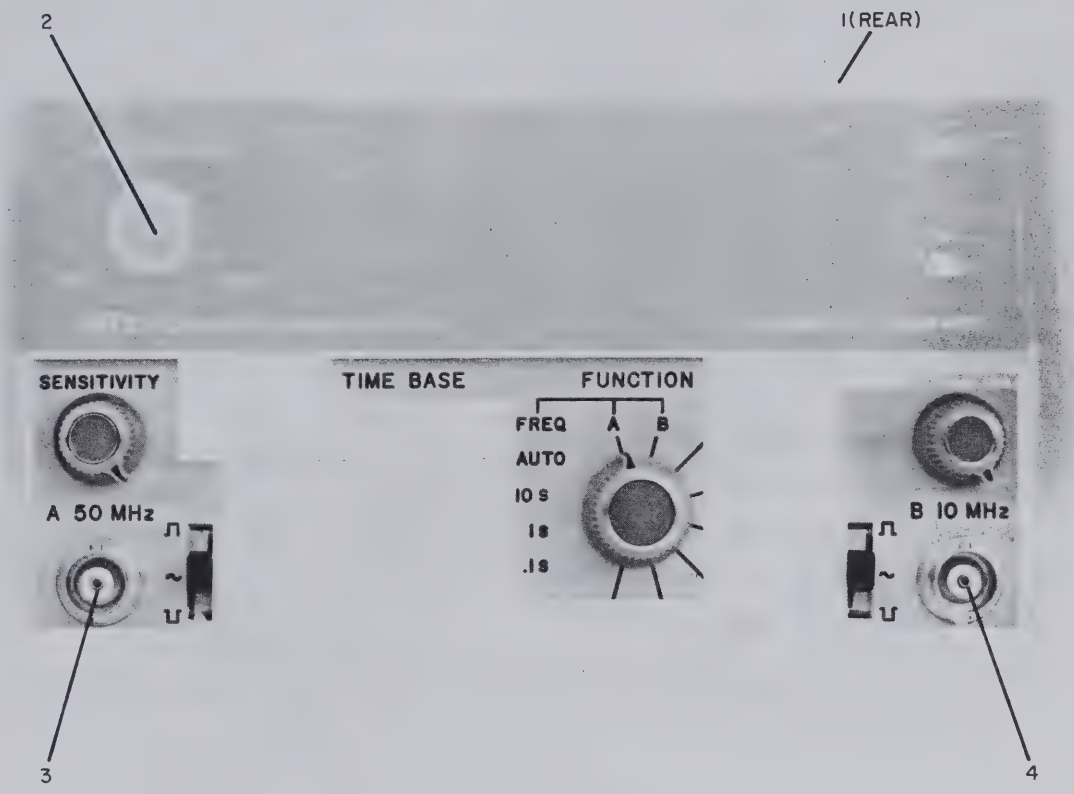


1. Connect ac power to 5300A ac receptacle.

2. Turn ac power "on" with 5300A SAMPLE RATE control. Adjust SAMPLE RATE for desired display time.

3. Set 5302A FUNCTION SWITCH TO CHECK; TIME BASE switch may be set to any position. Display should be 10.0000 MHz ± 1 count.

Figure 9B-3-5. Making Frequency Measurements Using Channel A or B



1. Connect ac power to 5300A ac LINE receptacle.

2. Turn ac power "on" with 5300A SAMPLE RATE control and adjust sample rate for desired display time.

3. For frequencies 10 Hz to 50 MHz use Channel A as follows:

 a. Set FUNCTION to "A".

 b. Set "A" Waveform switch to " ∿ " and TIME BASE to an appropriate gate time (see paragraph 9B-3-8 for Waveform controls operating information). For low duty cycle pulse measurements where pulse widths are short compared to pulse spacing, set Waveform "A" switch to " ⎍ " or to " ⎏ " depending on input pulse polarity.

 c. Set "A" SENSITIVITY to full ccw (see SENSITIVITY CONTROLS operating information, paragraph 9B-3-5).

 d. Connect input signal to be measured to "A 50 MHz" connector.

 e. Slowly adjust SENSITIVITY cw for a stable display.

 f. Set TIME BASE to desired gate time.

 g. Instrument display is the input signal frequency.

4. For frequencies 10 Hz to 10 MHz use Channel B as follows:

 a. Set FUNCTION to "B".

 b. Set "B" Waveform switch to " ∿ " and TIME BASE to an appropriate gate time (see paragraph 9B-3-8 for Waveform Controls operating information). For low duty cycle pulse measurements where pulse widths are short compared to pulse spacing, set Waveform "B" switch to " ⎍ " or to " ⎏ " depending on input pulse polarity.

 c. Set "B" SENSITIVITY to full ccw (see SENSITIVITY CONTROLS operating information, paragraph 9B-3-5).

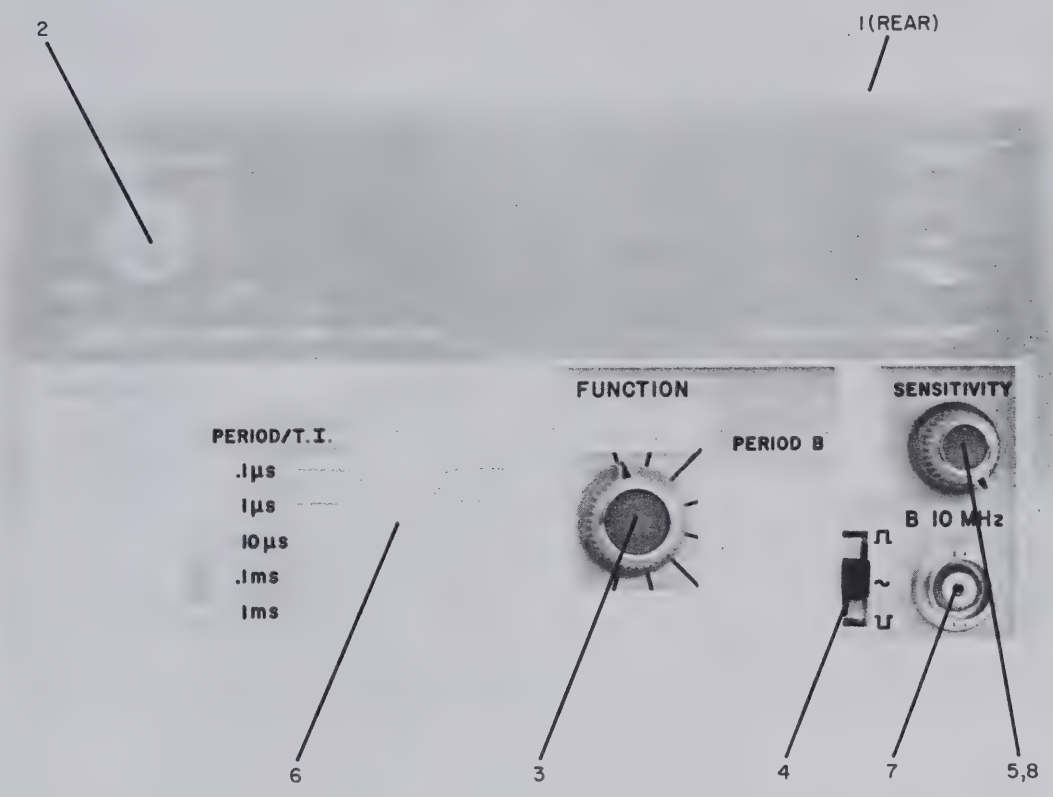
 d. Connect input signal to be measured to "B 10 MHz" connector.

 e. Slowing adjust "B SENSITIVITY control cw for a stable display.

 f. Set TIME BASE to desired gate time.

 g. Instrument display is the input signal frequency.

Figure 9B-3-6. Making Period Measurements



1. Connect ac power to 5300A ac LINE receptacle.

2. Turn ac power "on" with 5300A SAMPLE RATE control. Adjust SAMPLE RATE for desired display time.

3. Set 5302A FUNCTION switch to PERIOD B.

4. Set "B" Waveform switch to correspond to type of signal being measured (see Paragraph 9B-3-8 for Waveform Controls operating information).

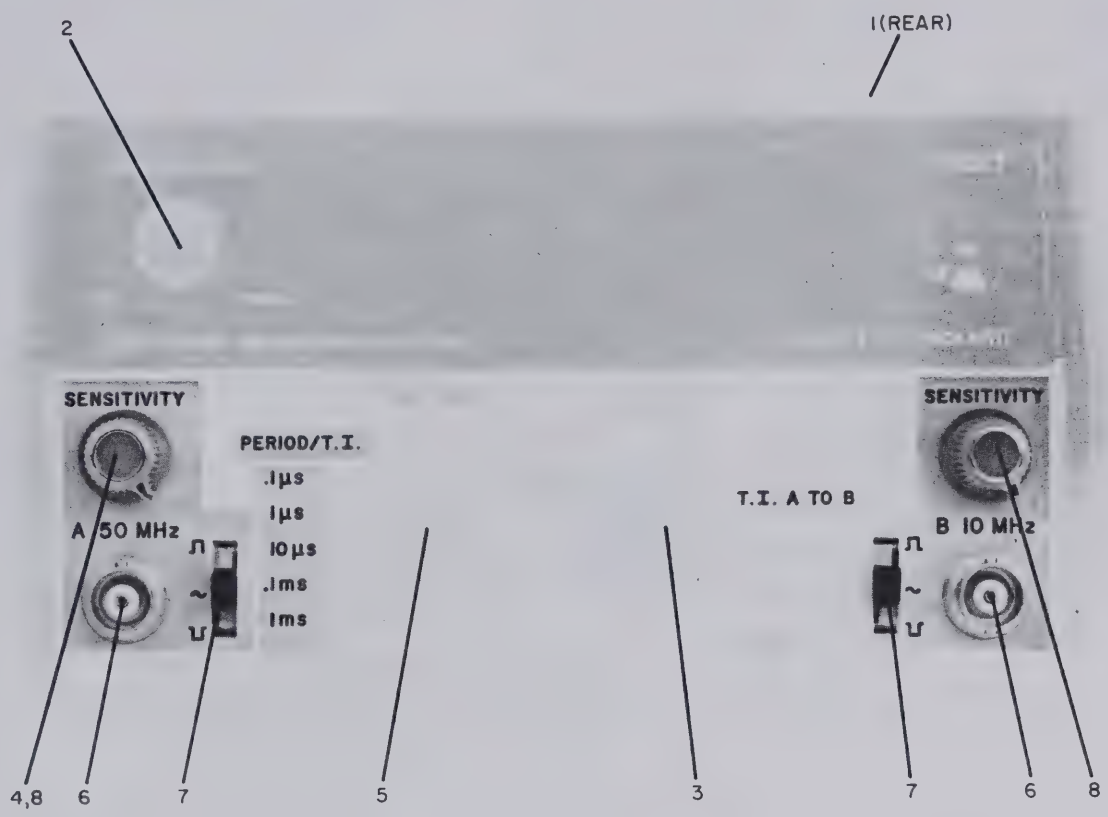
5. Adjust "B" SENSITIVITY to full ccw (see Paragraph 9B-3-5 for SENSITIVITY CONTROLS operating information).

6. Set TIME BASE to desired PERIOD resolution (.1 µs to 1 ms).

7. Connect input signal (10 Hz to 1 MHz) to "B 10 MHz" connector.

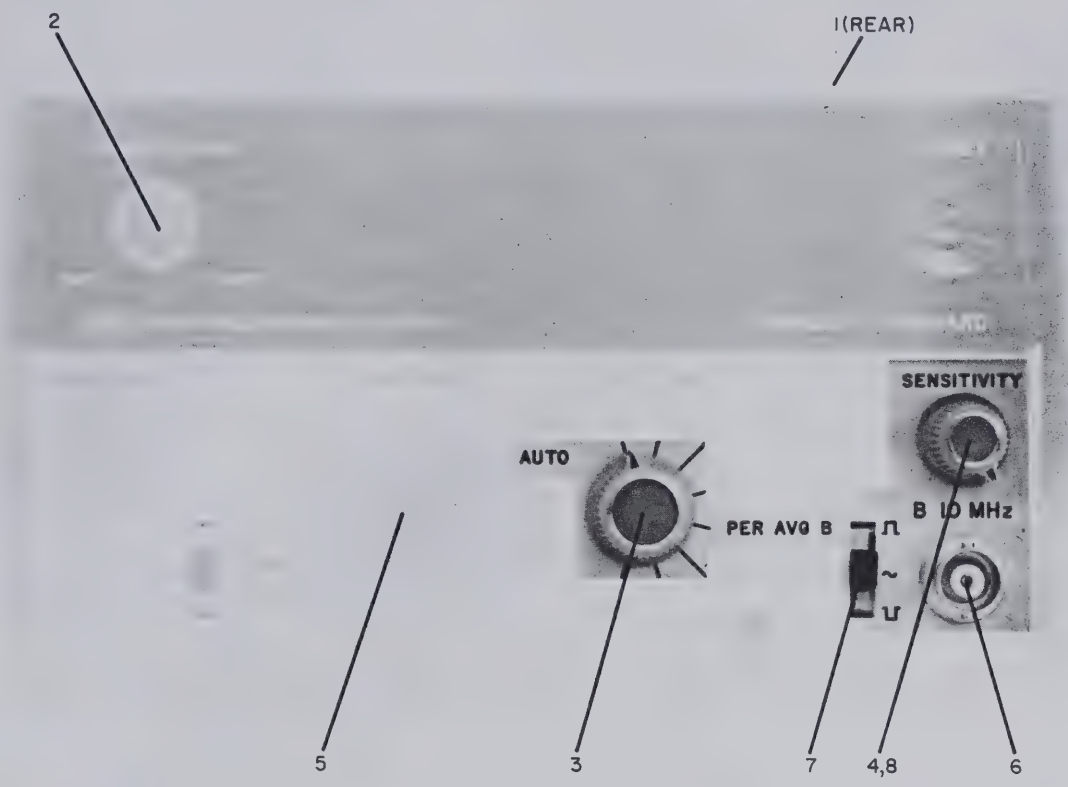
8. Adjust "B" SENSITIVITY control slowly cw for a stable display.

Figure 9B-3-7. Making Time Interval Measurements



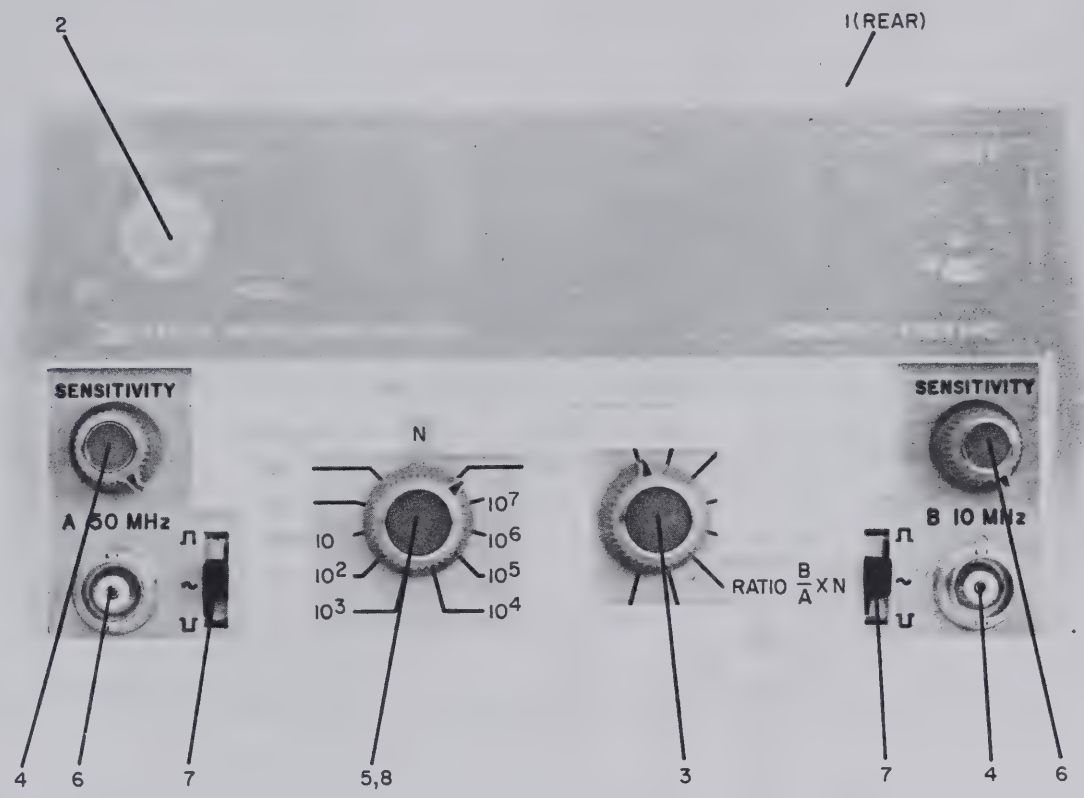
1. Connect ac power to 5300A ac LINE receptacle.
2. Turn ac power "on" with 5300A SAMPLE RATE control and adjust sample rate for desired display time.
3. Set 5302A FUNCTION switch to T.I. A to B.
4. Adjust "A" SENSITIVITY control to full ccw and "B" SENSITIVITY controls to full cw (see paragraph 9B-3-5 for SENSITIVITY CONTROLS operating information).
5. Set TIME BASE to desired T.I. resolution to be counted (.1 µs to 1 ms).
6. If the Start and Stop signals are from separate sources connect the Start signal to "A 50 MHz" connector and the Stop signal to "B 10 MHz" connector. If the Start and Stop signals are from a common source, use a BNC "Tee" connector to interconnect the signal source, "A 50 MHz" channel and "B 10 MHz" channel.
7. Set the "A" Waveform switch to correspond to the type of signal connected to A 50 MHz connector. Set the "B" Waveform switch to correspond to the type of signal connected to B 10 MHz connector.
8. Slowly adjust the "A" SENSITIVITY cw until a display is observed, then adjust "B" SENSITIVITY slowly ccw until the display is stable.
9. The Time interval is displayed in µsec, msec, or seconds depending on T.I. setting selected.

Figure 9B-3-8. Making Period Average Measurements



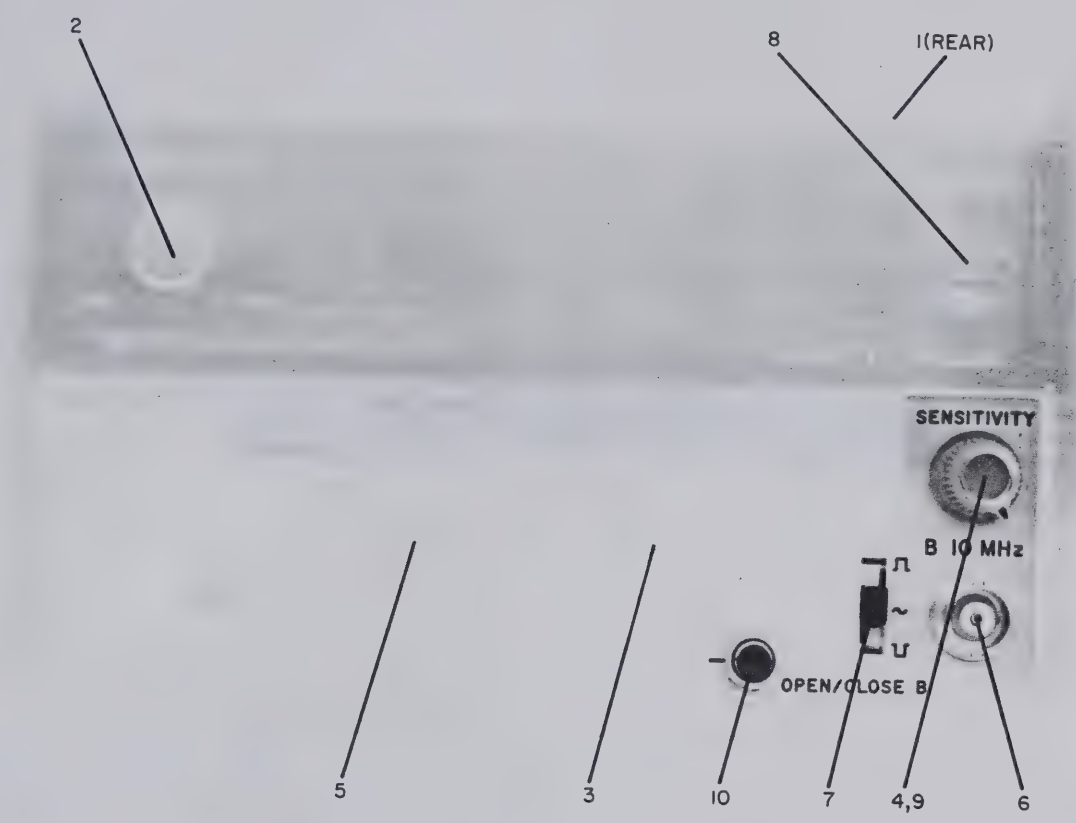
1. Connect ac power to 5300A ac LINE receptacle.
2. Turn ac power "on" with 5300A SAMPLE RATE control. Adjust SAMPLE RATE for desired display time.
3. Set 5302A FUNCTION to PER AVG B.
4. Adjust "B" SENSITIVITY to full ccw (see Paragraph 9B-3-5 for SENSITIVITY CONTROLS operating information).
5. TIME BASE adjustment is not required; instrument gate-time is automatic. Periods averaged are 1 to 10^3.
6. Connect input signal (10 Hz to 1 MHz) to "B 10 MHz" connector.
7. Set "B" Waveform switch to correspond to type of signal being measured (see Paragraph 9B-3-8 for Waveform Controls operating information).
8. Adjust "B" SENSITIVITY control slowly cw for a stable display.

Figure 9B-3-9. Making Ratio Measurements



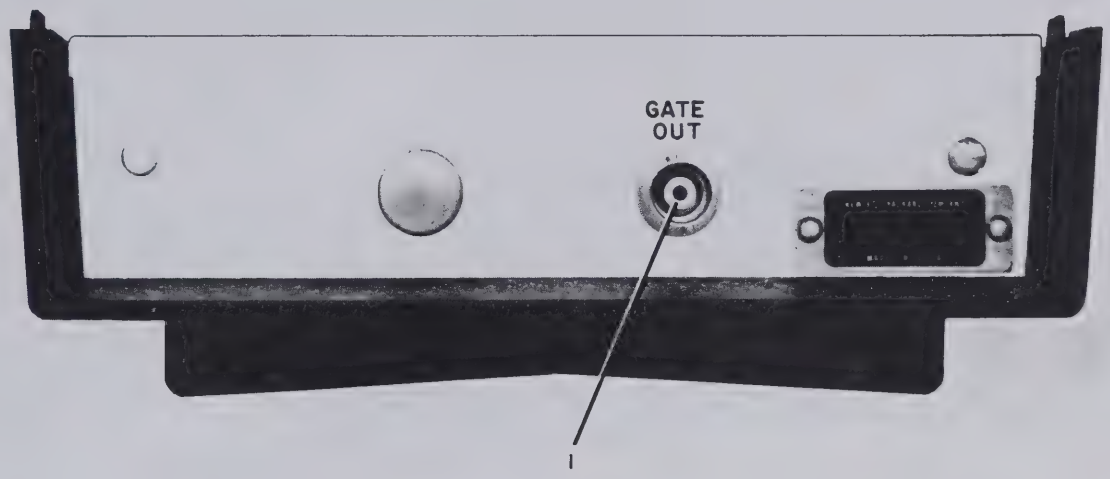
1. Connect ac power to 5300A LINE receptacle.
2. Turn ac power "on" with 5300A SAMPLE RATE control and adjust sample rate for desired display time.
3. Set 5302A FUNCTION switch to RATIO $\frac{B}{A}$ X N.
4. Set "A" and "B" SENSITIVITY controls full cw (see Paragraph 9B-3-5 for SENSITIVITY CONTROLS operating information).
5. Set TIME BASE N (white) to desired setting (10 white to 10^7 white).
6. Connect lower frequency signal to "A 50 MHz" connector (10 Hz to 1 MHz); connect higher frequency signal to "B 10 MHz" connector (10 Hz to 10 MHz).
7. Set "A" and "B" Waveform switches to correspond to type of signals connected to "A" and "B" input connectors.
8. Divide display by N multiplier setting (white numbers) to obtain ratio.

Figure 9B-3-10. Making Totalizing Measurements



1. Connect ac power to 5300A ac LINE receptacle.
2. Turn ac power "on" with 5300A SAMPLE RATE control. Adjust SAMPLE RATE for desired display time.
3. Set 5302A FUNCTION to OPEN/CLOSE B.
4. Adjust "B" SENSITIVITY to full ccw (see paragraph 9B-3-5 for SENSITIVITY CONTROLS operating information).
5. TIME BASE adjustment is not required; instrument gate is controlled by operator when OPEN/CLOSE B pushbutton is pressed.
6. Connect input signal (10 MHz maximum) to "B 10 MHz" connector.
7. Set "B" Waveform switch to correspond to type of signal being totalized (see paragraph 9B-3-8 for Waveform Controls operating information).
8. Press RESET; press OPEN/CLOSE B switch; C lamp should come on.
9. Slowly adjust "B" SENSITIVITY cw until counting occurs on display. Display will accumulate at a rate dependent on input signal frequency.
10. When display has accumulated the desired number of counts, press OPEN/CLOSE B to stop totalizing.
11. If the operator wants to totalize from the number accumulated in the display, press the OPEN/CLOSE B switch. If a new totalizing measurement is made, press RESET before pressing OPEN/CLOSE B switch.

Figure 9B-3-11. Using GATE OUT Connector



The 5302A rear-panel GATE OUT connector provides a TTL low level signal during the time the instrument gate is open. This signal can be used, when making Period, Time Interval and Period Average measurements, to control an oscilloscope so that only the measured portion of the signal is displayed by the oscilloscope.

1. To use this feature in Period (Figure 9B-3-6) or Period Average (Figure 9B-3-8) modes proceed as follows:

 a. Connect the signal to be measured to oscilloscope Channel A or B. Connect the 5302A GATE OUT connector, using a BNC Tee, to the oscilloscope rear-panel Z AXIS input and the oscilloscope front-panel EXT INPUT.

 b. Set HP 180A oscilloscope controls as follows:

 TRIGGER to EXT.

 SLOPE to +.

 Display to A + B.

 Coupling to ACF.

 SWEEP MODE to NORM.

 TIME/CM for one complete cycle of signal.

 c. Set remaining oscilloscope controls for a useable display.

 d. To more easily view the measured portion of the input signal, reduce the oscilloscope INTENSITY.

 e. In PER AVG Mode, the periods averaged are automatically selected. The change-over point may be monitored by varying the input frequency and observing the number of cycles displayed on the oscilloscope.

2. To use this feature in Time Interval Mode (Figure 9B-3-7) proceed as follows:

 a. Connect equipment as shown in Table 9B-5-1, No. 6, Figure C, Time Interval Measurements.

 b. In addition to connections made in step a, connect 5302A GATE OUT connector, using a BNC Tee, to oscilloscope rear-panel Z AXIS input and to oscilloscope front-panel EXT INPUT.

 c. Set HP 180A oscilloscope controls as follows:

 TRIGGER to EXT.

 SLOPE to —.

 Coupling to ACF.

 SWEEP MODE to NORM.

 TIME/CM for one complete Time Interval of signal.

 d. Set remaining oscilloscope controls for a useable display.

 e. To more easily view the measured time interval portion of the input signals, reduce the oscilloscope INTENSITY.

SECTION IX B
5302A UNIVERSAL COUNTER
SUBSECTION IV
THEORY OF OPERATION

9B-4-1. INTRODUCTION

9B-4-2. This subsection describes the theory of operation for the 5302A 50 MHz Universal Counter. Basic operation of gates and certain amplifiers is located in Section IV of the 5300A portion of the manual.

9B-4-3. To simplify measurement making when using channel A and/or channel B, refer to operating information starting with paragraph 9B-3-1 for optimum adjustment of the various controls.

9B-4-4. 5302A CIRCUIT THEORY (Figure 9B-8-1)

9B-4-5. INPUT AMPLIFIERS. The input signals at J1 or J2 are coupled to input buffers Q1, Q2 through C1 or C2. Signals greater than ±7 volts are clipped by the diodes CR4, CR6, CR9, CR10. Gate bias for Q1 and Q2, is provided by breakdown diode CR7 and resistors R9 and R11. Q1 and Q2 provide impedance-conversion from the 1 megohm INPUT to the 1 kΩ SENSITIVITY controls R1 and R2. R1 and R2 adjust the signal amplitude applied to the differential amplifiers U8A and U13A. The signal is limited to 1.4V p-p by CR1, CR3, and CR2, CR5. The differential amplifiers are biased at the proper point by R12, R13, R15, and R16 from the differential amplifiers' internal bias supply.

9B-4-6. In channel A, the U13A differential output is fed to the differential Schmitt-Trigger U13C, which converts the signal to fast risetime square waves compatible with digital logic, and rejects noise which may be present with the desired signal. Buffer stage U13B drives the prescaler and level converter.

9B-4-7. In channel B the U8A amplifier output is fed to the Schmitt-Trigger, U8C. U8B is a unity-gain amplifier whose output supplies the Schmitt-Trigger bias voltage, and buffers it from the input bias source.

9B-4-8. A dc offset voltage in the "pulse positions" of S1 or S2 is applied to the amplifiers and Schmitt-Triggers to make them handle low duty-cycle pulses. In channel A the offset is applied directly to the Schmitt-Trigger through R5 or R6. In channel B the offset is applied to the input amplifier through R3 or R4.

9B-4-9. Channel A signals are available to the logic circuits either direct or prescaled by 10 through U18 and U19. In the Frequency Mode, the signals at the output of buffer U13B go to the ECL decade-divider U18 and U19. The prescaled output from the decade goes to U26A, which converts the ECL logic levels to TTL levels for use in the remainder of the 5302A.

9B-4-10. In Time Interval and Ratio measurements an unprescaled output is desired and the channel A signal is taken from buffer amplifier U13B directly to a level-translator gate U26E. To ensure that the leading edge of the signal triggers the circuitry, the "CHAN A" signal goes to EXCLUSIVE OR gate U27C(9). The other input of this gate is controlled by the channel A waveform switch S1. In the ⊓ and ∿ positions, this input is low, while in the ⊓ position, it is pulled high through R52. Thus, in ⊓ pulse and ∿ the gate (U27C) acts as a non-inverting buffer while in ⊓ it acts as an inverter.

9B-4-11. The output of the channel B Schmitt-Trigger goes directly to the U26(3,4) level-translator gate and then to an EXCLUSIVE OR Inverter/Buffer described in paragraph 9B-4-10.

9B-4-12. FREQUENCY MODE (Figures 9B-5-2 and 3)

9B-4-13. In frequency A or frequency B modes, the signal from one of the input amplifiers CHA "OUT" and CHB "OUT" is applied to F1 A1P1(5) through U16 F1 switch. The F1 frequency is determined by counting F1 for an accurately known period of time. This counting time or gate-time can be .01 sec, .1 sec, 1 sec, or 10 sec, depending upon frequency and resolution desired.

9B-4-14. Accurate measurement periods are derived from a 10 MHz crystal-controlled oscillator through a chain of 8-decade dividers. The outputs of the dividers are multiplexed onto a single line and gated to provide a series of 9 pulses in 10 seconds. The first, or start pulse indicates "time zero" and the beginning of a measurement cycle (see Figure 9B-4-1). The other pulses are generated at precisely 1 µsec, 10 µsec, 100 µsec, 1 ms, 10 ms, 100 ms, 1 sec, and 10 sec after the start pulse. Because the pulses are logarithmically spaced in time, this line is termed "$\overline{\text{LOG}}$" output. Another timing signal, TB OUTPUT, (time base output), is available which gives a level change concurrent with one of the $\overline{\text{LOG}}$ pulses (see Figure 9B-4-2). The specific time from the start pulse to this level change is programmed by a three-line code (TB SELECT A, B, C).

Figure 9B-4-1. LOG Cycle

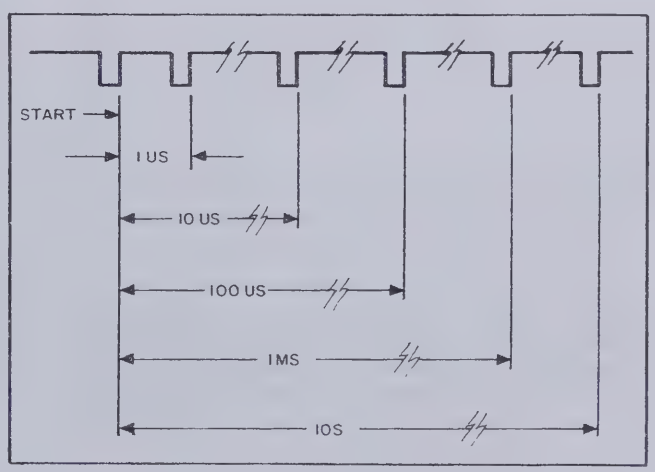
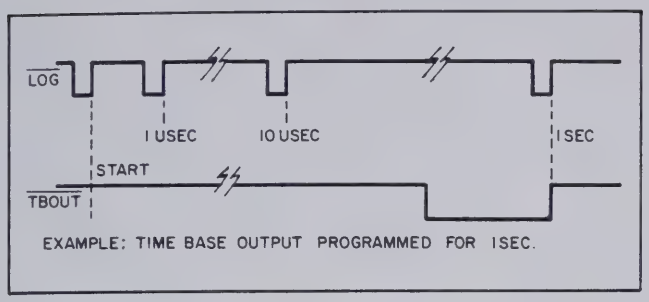


Figure 9B-4-2. TIME BASE/LOG Outputs

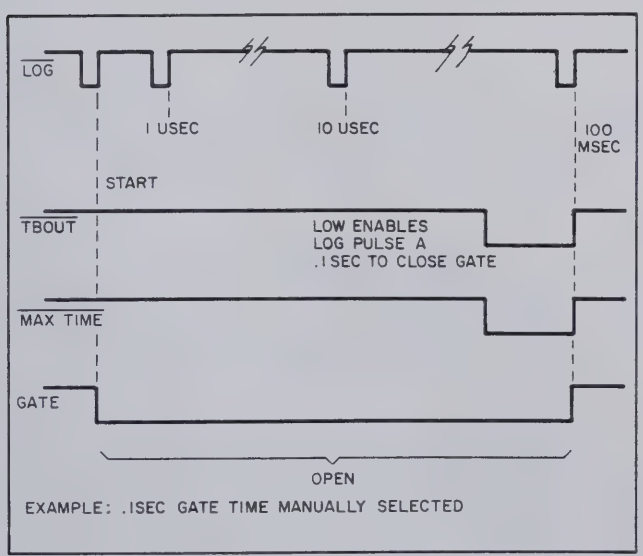


9B-4-15. The eight-decade dividers and the logic to control LOG and TIME BASE OUTPUT are all contained in a single MOS-LSI Integrated Circuit in the 5300A mainframe.

9B-4-16. The main gate which controls the flow of F1 into the counting decades, is opened by the Start Pulse and is closed by one of the other eight Log Pulses. The closing can be enabled by either of two lines going to a low state, "$\overline{9}$" and MAX TIME.

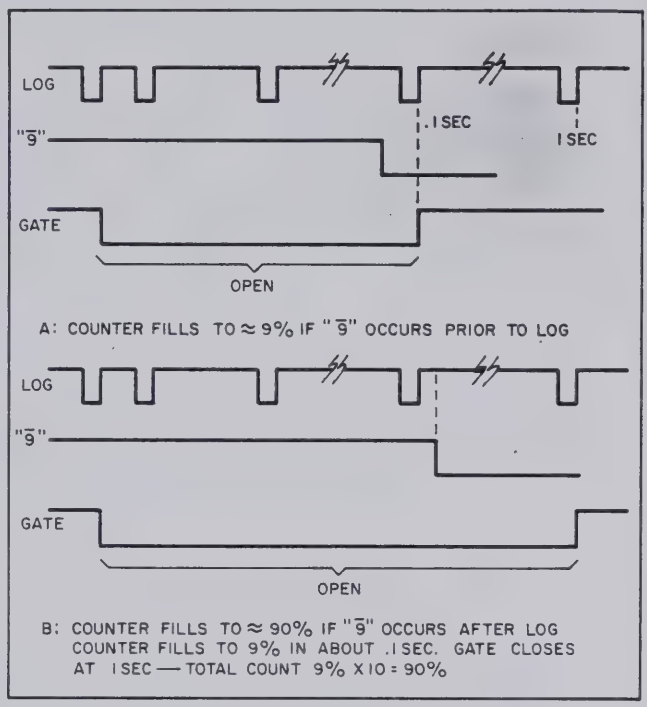
9B-4-17. MANUAL GATE SELECTION. Manually selecting 10s, 1s, or .1s gate times, generates an appropriate code which programs the time base output so that immediately preceding the correct LOG pulse, the TIME BASE OUTPUT goes low (see Figure 9B-4-3). MAX TIME is immediately pulled low by the 5302A through Q3 and U12A and enables the closing of main gate. The next LOG pulse closes the Main Gate and terminates the measurement.

Figure 9B-4-3. Manual Gate Selection



9B-4-18. AUTO GATE Selection. In automatic mode (Timing shown in Figure 9B-4-4) the control line "$\overline{9}$" is enabled (forced high state is removed), and the counting cycle starts as in manual gate selection. When the display reaches 9% of capacity, 090000 counts, the "$\overline{9}$" line goes low, enabling gate closing on the next LOG pulse. This AUTO feature means that the display will be from 9% to 90% full; 9% if "$\overline{9}$" goes low *just before* a LOG pulse and 90% if it occurs *just after* a LOG pulse. To prevent the gate time in AUTO from becoming excessively long with low input frequencies, a 1 second maximum is placed on it, by coding 1 second into the TB OUTPUT. Thus, on signals from 10 Hz to 900,000 Hz, the gate time is 1 sec; from 900,001 Hz to 9.0 MHz the gate time is .1 sec, and above 9.0 MHz the gate time is .01 sec.

Figure 9B-4-4. AUTO GATE Selection



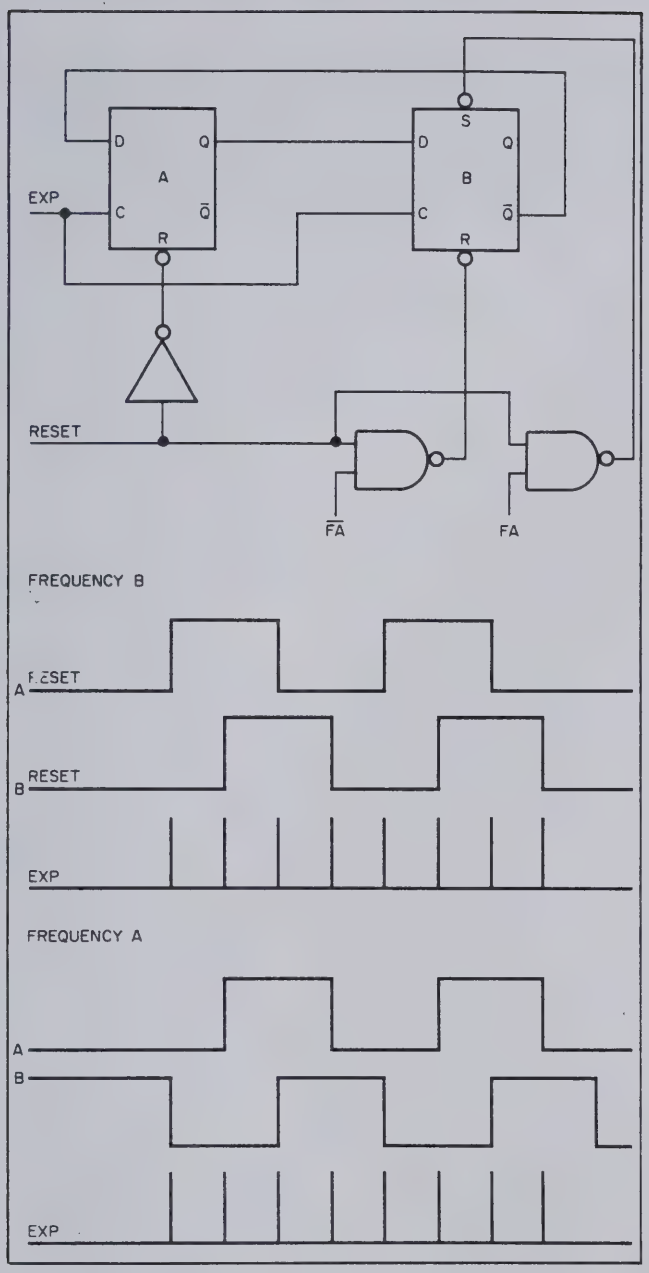
9B-4-19. In automatic operation (AUTO), the gate time is not known until the end of the measurement; the proper decimal point or units annunciators must then be determined. The length of the gate time is determined by counting the EXPONENT signal, which is the "LOG" signal that occurs while the gate is open (i.e., LOG without the start pulse). The exponent is counted by the 4-bit ripple counter consisting of U22A and U22B.

9B-4-20. The 5302A has four possible gate times; .01 second, .1 second, 1 second and 10 seconds. The .01, .1 and 1 second times are available in AUTO or "manual" positions. The 10 second gate-time is available only in "manual" position (10 S).

9B-4-21. The outputs of the exponent counter are stored in the exponent storage latches U21A,B during the measurement cycle. The outputs of these latches are then used in decoding.

9B-4-22. All frequency-related decimal point and units information is derived from the four-state exponent counter U22A and B (see Figure 9B-4-5). The channel A prescaling and the decoding used makes it necessary to reset the exponent counter to different initial states as shown in Table 9B-4-1.

Figure 9B-4-5. Exponent Counter



9B-4-23. PERIOD AND TIME INTERVAL MODES (Figures 9B-5-4 and 9B-5-5)

9B-4-24. The logic circuits for period and time interval measurement are common except for source selection. In period mode, successive leading edges of the channel B waveform open, then close, the main gate; while in Time Interval Mode, a leading edge of the channel A waveform opens the gate and the next leading edge of the channel B waveform closes the gate.

9B-4-25. In Period and Time Interval Mode the clock or timebase output is counted for one period of the input signal or for the time interval between two selected signals. The clock or timebase output signal is sent to the 5300A as F1 (A1P1(5)) through U16 F1 switch. The timebase is controlled by S2 through Time Base decoders U3A, U3B and U4A. The three-bit Time Base code is shown in Table 9B-4-1.

Table 9B-4-1. TIME BASE CODE

	TBC	TBB	TBA
1 μs	0	0	0
10 μs	0	0	1
.1 ms	0	1	0
1 ms	0	1	1
10 ms	1	0	0
.1 S	1	0	1
1 S	1	1	0
10 S	1	1	1

9B-4-26. The 5300A main gate is controlled by $\overline{\text{OPEN}}$ and $\overline{\text{CLOSE}}$ signals from U5A and U17B which gates the outputs of U7A. In Period Mode, channel B clocks U7A through U11 while in Time Interval channel A, *then* channel B clocks U7A through U11. In time interval mode U6C and U6D control the application of channel A or channel B signals to U7A. Latch U5A, D allows only one start pulse per display cycle.

9B-4-27. In period and time interval modes, the display cycle is activated by pulling $\overline{\text{MAX TIME}}$ (A1P1(17)) low through C26, R46, CR16 and U12A when the 5300A main gate closes. Units and decimal points are decoded from the TIME BASE switch positions. The $\overline{\text{LOG}}$ signal is disabled in time interval and period modes (pulled low) to prevent opening of the 5300A main gate.

9B-4-28. OPEN/CLOSE B MODE (Figure 9B-5-8)

9B-4-29. In open/close mode the channel B input is counted while the 5300A main gate is open. Channel B signal is fed to A1P1(5) as F1 signal by U16 F1 switch. The main gate is controlled by the front-panel pushbutton switch S4 through OPEN/CLOSE B latch U1B and U1C which conditions the switch signal. The OPEN/CLOSE latch signal is routed through U11 data switch and "clocks" U7A flip-flop. The output from U7A goes to U5A and U17B which generate the $\overline{\text{OPEN}}$ and $\overline{\text{CLOSE}}$ signals used to control the 5300A main gate. The $\overline{\text{TRANSFER}}$ line (A1P1 (20)) is set low to continuously transfer count information from the decades to the display. The $\overline{\text{LOG}}$ and $\overline{\text{MAX TIME}}$ lines are both inhibited; $\overline{\text{LOG}}$ is inhibited to prevent the gate from opening; $\overline{\text{MAX TIME}}$ is inhibited to prevent the display cycle from being initiated when the gate closes. The TIME BASE switch S2 is disabled through U2B and U5B in OPEN/CLOSE B mode.

9B-4-30. PER AVG B MODE (Figure 9B-5-6)

9B-4-31. Period Average function is totally automatic and operates similar to AUTO frequency mode except that the clock and input signals are interchanged. The clock signal is routed through U16 to F1 and counted, while channel B signal is fed through U12B and U15A to A1P1 (21) 1 MHz IN TB. The count will terminate after 1, 10, 100, or 1000 periods of the channel B input signals. U7B synchronizes the signal so that the first pulse is full width. The count termination is initiated either by a full display ($\overline{9}$) or by $\overline{\text{TBO}}$ signals. $\overline{\text{TBO}}$ is set so that a maximum of 1000 periods is averaged. Unit and decimal-point-decoding is from the output of the exponent counter latches U22A and B. Since period average is fully automatic, the timebase switch S2 is disabled by U2B.

9B-4-32. RATIO MODE (Figure 9B-5-7)

9B-4-33. In Ratio mode the channel B signals are counted for a given number of periods of channel A. The number selected by the time base switch position (white numbers) determines the number of periods. The channel B signal is routed to F1 by U16 and the channel A signal is routed to 1 MHz IN TB by U12B and U15A. The first pulse on the 1 MHz IN TB line is synchronized by U7B. No decimal point or units are decoded in ratio mode. F2 switch U25B and U15C, disable the clock from F2 at A1P1(7).

9B-4-34. CHECK MODE (Figure 9B-5-9)

9B-4-35. Setting the FUNCTION switch S3 to Check Mode (CHK) applies the 10 MHz clock through U16 to F1 at A1P1(5) and switches to automatic frequency mode via diode CR12. The TIMEBASE switch S2 is disabled through U5B and U2B.

SECTION IX B
5302A UNIVERSAL COUNTER
SUBSECTION V
MAINTENANCE

9B-5-1. INTRODUCTION

9B-5-2. This section contains maintenance and service information for Model 5300A/5302A 50 MHz Universal Counter. Included are performance check procedures and tests to localize, isolate, and locate defective components.

9B-5-3. RECOMMENDED TEST EQUIPMENT

9B-5-4. Test equipment recommended for performance checks, maintaining, troubleshooting and servicing the 5300A/5302A 50 MHz Universal Counter is listed in Table 5-1 of 5300A portion of the manual. Test equipment with equivalent characteristics may be substituted for equipment listed.

9B-5-5. INSTRUMENT ACCESS

9B-5-6. For access to plug-on assembly, separate the 5300A from the 5302A as follows:

a. Turn ac power OFF and disconnect power cord.

b. Pull the two-side casting latches fully rearward (it is necessary to press the latch handles gently away from the center of the instrument to unlock them).

c. When latches are fully extended rearward, the 5300A and 5302A castings should be separated by about ⅛ inch.

d. Lift the 5300A gently away from the 5302A.

e. Separate 5302A 50 MHz BOARD ASSEMBLY from 5302A casting as follows (refer to Figure 9B-5-1):

1. Press rear, plastic-nylon retaining clips on each side of 5302A casting and lift the rear of the 50 MHz Board Assembly to release it from the castings

2. Press front plastic-nylon retaining clips on each side of 5302A casting and lift the front of the 50 MHz Board Assembly to release it from the casting.

3. Lift 50 MHz Board Assembly from the casting.

f. Mate the 5302A 50 MHz Board Assembly to 5300A and reapply ac power.

g. To reinstall the 50 MHz Board Assembly into the casting reverse procedure of steps d through f.

9B-5-7. PERIODIC MAINTENANCE

9B-5-8. To determine if the 5300A/5302A is operating properly within specifications, perform the In-Cabinet Performance Checks listed in Table 9B-5-1. These checks may also be used for the 5300A performance checks when the 5300A/5302A combination is used.

9B-5-9. MAINTENANCE AND REPAIR

9B-5-10. BOARD REMOVAL. When removing the printed circuit board for replacement, repair, or servicing, always remove ac power and separate the board from the casting g Paragraph 9B-5-6 steps a to e.

9B-5-11. COMPONENT REPLACEMENT. When replacing a circuit board component use a low heat soldering iron. Heat must be used sparingly as damage to the circuit foil may result. Mounting holes may be cleaned out with a toothpick while heat is applied. Connection should be cleaned with a cleaning solution after component removal and replacement.

9B-5-12. INTEGRATED CIRCUIT REPLACEMENT. Two methods are recommended for removing integrated circuits:

a. Solder Gobbler. Solder is removed from board by a soldering iron with a hollow tip connected to a vacuum source. The IC is removed intact so it may be reinstalled if diagnosis is wrong.

b. Clip Out. This method is used when an IC is proven defective. Clip leads close to case, apply heat and remove leads with long nose pliers. Clean board holes with a toothpick and cleaning solution.

9B-5-13. INSTRUMENT TROUBLESHOOTING

9B-5-14. Trouble isolation can best be accomplished by first obtaining all possible information from the controls, connectors, and indicators on the 5300A and 5302A, then logically using this information to locate the defective component. If the performance checks indicate a malfunction or if instrument operation is suspect, perform the Self-Check procedures in Table 9B-5-1. For further tests, separate the 5302A from the casting and reconnect to 5300A using Paragraph 9B-5-6 steps a to e as a guide. Operating procedures in Subsection 9B-3 can be used to help understand operation. To test the 5302A, obtain the test equipment listed in Table 5-1 of the 5300A portion of the manual

9B-5-15. Figure 9B-5-2 to Figure 9B-5-9 are troubleshooting flow diagrams for each of the eight modes of operation. Signal flow is outlined for each mode and waveform test points and voltage level test points are indicated. The waveform or voltage level for each mode is included with the figures.

9B-5-16. FREQ "A" MODE TROUBLESHOOTING

9B-5-17. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to "A"; TIME BASE to .1 S; channel A waveform switch to "∩"; SENSITIVITY to max cw.

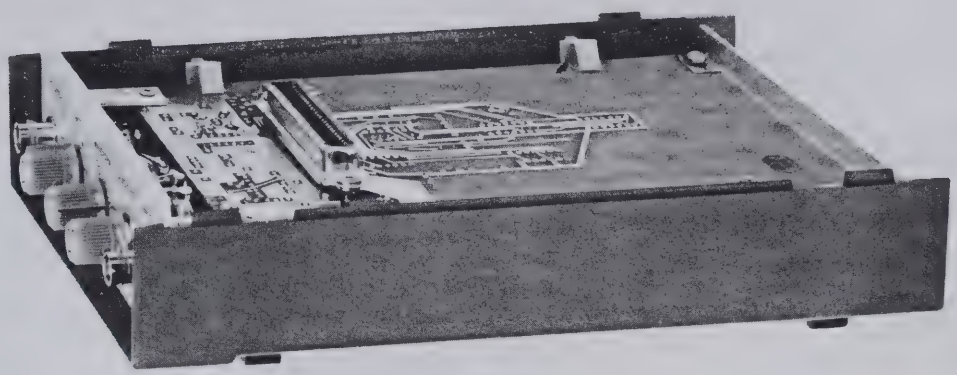
b. Connect a 651B Oscillator, 50-ohm output, set for 10 MHz, 100 mV rms to 5302A "A" 50 MHz connector.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-2.

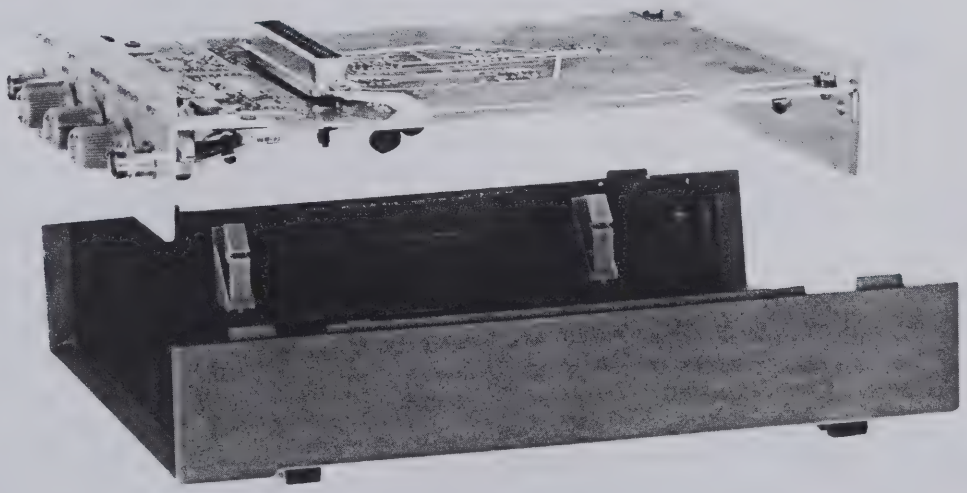
d. 5300 display should be the same as the input frequency.

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

Figure 9B-5-1. Separation Procedure



STEP A



STEP B

9B-5-18. FREQ "B" MODE TROUBLESHOOTING

9B-5-19. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to "B"; TIME BASE to .1 S; channel B waveform switch to "∿"; SENSITIVITY to max cw.

b. Connect a 651B Oscillator, 50 ohm output, set for 10 MHz, 100 mVrms to 5302A "B" 10 MHz connector.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-3.

d. 5300 display should be the same as the input frequency.

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-20. PERIOD B MODE TROUBLESHOOTING

9B-5-21. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to PERIOD B; TIME BASE to 1 μsec; channel B waveform switch to "∿"; SENSITIVITY to max cw.

b. Connect a 651B Oscillator, 50-ohm output, set for 1 MHz, 100 mV rms to 5302A "B" 10 MHz connector.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-4.

d. 5300 display should be 000001 μs .

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-22. TIME INTERVAL MODE TROUBLESHOOTING

9B-5-23. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to T.I. A to B; TIME BASE to 1 μsec; channel A and B waveforms switches "⊓"; SENSITIVITY (both channels) to max cw.

b. Connect two 222A Pulse Generators as shown in Table 9B-5-1, Figure C. Perform Table 9B-5-1, item 6, steps b through f, except with a time interval of 2 μsec.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-5.

d. 5300 display should be 000002 μs .

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-24. PERIOD AVERAGE MODE

9B-5-25. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to PER AVG B; (TIME BASE is inoperative), channel B waveform switch to "∿"; SENSITIVITY to max cw.

b. Connect a 651B Oscillator, 50-ohm output, set for 1 MHz, 100 mV rms to 5302A "B" 10 MHz connector.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-6.

d. 5300 display should be 01.0000 μs.

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-26. RATIO MODE TROUBLESHOOTING

9B-5-27. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to RATIO $\frac{B}{A}$ X N; TIME BASE TO N = 10^3; channel A and B waveform switches to "∿"; SENSITIVITY (both channels to max cw.

b. Connect a 651B Oscillator, 50-ohm output, set for 1 MHz, 100 mV rms to 5302A "A" 50 MHz connector. Connect another 651B oscillator, 50-ohm output set for 10 MHz, 100 mV rms to 5302A "B" 10 MHz connector.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-7.

d. 5300 display should be 010000.

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-28. OPEN/CLOSE (TOTALIZE) MODE TROUBLESHOOTING

9B-5-29. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to OPEN/CLOSE; (TIME BASE is inoperative) channel B waveform to "∿"; SENSITIVITY to max cw.

b. Connect a 651B Oscillator, 50-ohm output, set for 10 Hz, 100 mV rms to 5302A "B" 10 MHz connector.

c. Press 5300A RESET, press 5302A OPEN/CLOSE switch. 5300 display should accumulate at a .1 second rate.

d. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-8.

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-30. CHECK MODE TROUBLESHOOTING

95-5-31. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to CHECK; TIME BASE to AUTO.

b. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-9.

c. 5300 display should be 10 MHz ±1 count.

d. When using the logic probe, a High level is indicated by probe lamp "on". A Low level indicated by probe lamp "off".

9B-5-32. If trouble is traced to the 5300A mainframe, refer to 5300A Measuring System maintenance information located in Section V of the 5300A portion of the manual.

9B-5-33. SENSITIVITY ADJUSTMENT PROCEDURE (PREFIX 1112A OR 1332A ONLY)

9B-5-34. If channel A or channel B fail to meet their sensitivity specifications, as tested in Table 9B-5-1, items 2 and 3, perform the following procedure:

a. Connect an HP 651B Oscillator, set to 100 kHz/ 50m Vrms/50 Ohms to channel A input.

b. Set 5302A SENSITIVITY (both channels) mac cw and TIME BASE to 1S; 5300A display should be 0.10000 MHz C.

c. If the display is erratic or all zeros, increase the 651B signal level until counting and display occurs.

d. Note the input signal level; obtain several ⅛W 1% resistors ranging from 10K ohms down to 500 ohms. Starting with the 10K ohm resistor, connect these resistors, one at a time, in parallel with R16.

e. Reduce the input signal level until counting stops or is erratic. Note the input signal level.

f. Remove the parallel resistor and connect another resistor of lower value across R16.

g. Reduce the input signal level until counting stops or is erratic.

h. Repeat steps a through g until a display can no longer be obtained when the parallel resistor value is decreased.

i. At this point, increase the signal level and/or the parallel resistor value until counting and display occurs within specifications.

j. Calculate the effective resistance of R16 - Parallel resistor combination and install that value in place of R16.

k. The minimum specified input signal level for 5302A channel A is 50 mV rms (typical levels may be less than 50 mV).

l. Repeat steps a through k for channel B. Display for channel B should be 100.000 kHz C.

9B-5-35. SENSITIVITY ADJUSTMENT PROCEDURE (PREFIX 1444A)

9B-5-36. Follow procedure given in paragraph 9B-5-33 except use controls A1R57 for maximum sensitivity in channel B and control A1R59 for adjusting channel A. Control A1R59 for Channel A is closest to the front panel; A1R57 for Channel B is toward the rear. The controls are centrally located along one edge of the circuit board. Resistor substitutions are not required on circuit boards with the added sensitivity controls.

Table 9B-5-1. In-Cabinet Performance Checks

1. CHECK Mode

a. Ensure 5300A OSC switch is at INT.

b. Mate 5300A to 5302A and ensure side casting latches at rear of 5300A are latched.

c. Connect ac power to 5300A ac receptacle.

d. Turn ac power "on" with 5300A SAMPLE RATE slightly cw out of OFF.

e. Set FUNCTION to CHECK; TIME BASE switch has no effect. Display should be 10.0000 MHz ± 1 count.

2. FREQ A Mode

RANGE: 10 Hz to 50 MHz.

Obtain following test equipment:

HP 651B Test Oscillator
HP 3200B VHF Oscillator
HP 11048B Feed-thru Termination

Table 5-1 in the 5300A portion of the manual and Table 9-5-1 lists equipment used; equipment with equivalent characteristics may be used.

a. Connect 651B 50-Ohm OUTPUT through the 50-Ohm feed-thru to 5302A "A-50 MHz" connector. Set 5302A FUNCTION to FREQ A, "A Waveform" Switch to "∿" and "A" SENSITIVITY to full cw.

b. Set 651B or 3200B to frequencies and output levels listed below: Display should be as listed.

651B or 3200B OUTPUT mV rms	651B FREQ. Hz Approximate	TIME BASE (Sec)	Approximate Display ± 1 Count ± Accuracy of Source
50 mV	10 Hz	10	000.010 kHz C
50 mV	10 kHz	10	010.000 kHz C
50 mV	100 kHz	1	0.10000 MHz C
50 mV	1 MHz	.1	01.0000 MHz C
50 mV	10 MHz	.1	10.0000 MHz C
	3200B FREQ. MHz Approximate		
100 mV	20	AUTO	20.0000 MHz
100 mV	40	AUTO	40.0000 MHz
100 mV	50	AUTO	50.0000 MHz

Table 9B-5-1. In-Cabinet Performance Checks (Continued)

3. FREQ B Mode

RANGE: 10 Hz to 10 MHz

Obtain the following test equipment:

HP 651B Test Oscillator
HP 11048B 50-Ohm Feed-thru Termination.

Table 5-1 of the 5300A portion of the manual lists equipment used; equipment with equivalent characteristics may be used.

a. Connect the 651B, set to 50 mV rms, through the 50-Ohm Feed-thru to the 5302A B 10 MHz connector.

b. Set 5302A FUNCTION to FREQ B; "B" SENSITIVITY to full cw; "B" Waveform switch to "∿".

c. Set the 651B to frequencies listed below. Display should be as listed:

651B FREQ. Hz Approximate	TIME BASE (Sec)	Approximate Display ± 1 Count ± Accuracy of Source
10 Hz	10	00.0100 kHz C
10 kHz	10	10.0000 kHz C
100 kHz	1	100.000 kHz C
1 MHz	.1	1.00000 MHz C
100 kHz	AUTO	100.000 kHz C
1 MHz	AUTO	1.00000 MHz C
10 MHz	AUTO	10.0000 MHz C

4. PULSE MEASUREMENTS Mode

Channel A and Channel B, "⎍" or "⎍" mode.

RANGE: 10 Hz to 1 MHz for Channel A. 10 Hz to 1 MHz for Channel B.

PULSE WIDTH: 50 nsec minimum.

Obtain the following test equipment:

HP Model 222A Pulse Generator
HP Model 11048B 50-Ohm Feed-thru Termination
HP Model 180A Oscilloscope
BNC Tee Connector.

a. Connect equipment as shown in Figure A.

b. Set 222A for "+" PULSE POLARITY; 50 nsec pulse width; 150 mV p-p (low duty cycle).

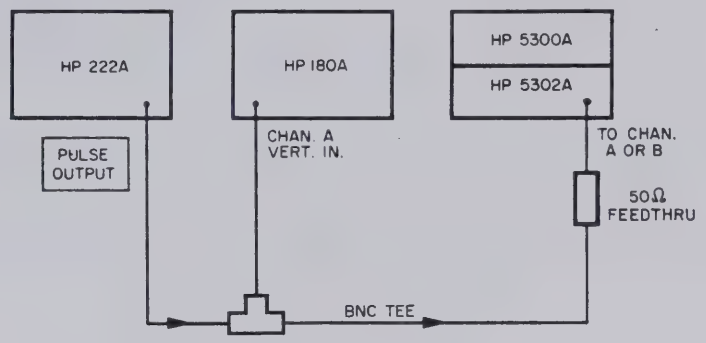
c. Monitor 222A pulse output with oscilloscope and set REP RATE for 10 Hz.

NOTE

For frequencies above 1 MHz slide switch S1 to "∿" position. A low duty cycle rate is required when making measurements in plus or minus pulse mode.

Table 9B-5-1. In-Cabinet Performance Checks (Continued)

Figure A. Connections for Pulse Measurements



d. Set 5302A SENSITIVITY to maximum ccw, Waveform Switch to "⎍ ", FUNCTION to FREQ A; TIME BASE to AUTO. Adjust SENSITIVITY cw until a stable display is obtained.

e. 5300A display should be approximately 10 Hz.

f. Repeat step d with 222A repetition rates of 10 kHz, 100 kHz, 1 MHz. The 5300A display should be the same as the 222A repetition rate setting.

g. Set 222A PULSE POLARITY to "-"; set Channel A Waveform switch to "⎍ ". Repeat steps b through f.

h. For Channel B, connect the pulse signal to Channel B 10 MHz connector; set FUNCTION to FREQ B.

i. Repeat steps b through g.

5. PERIOD B Mode

RANGE: 10 Hz (.1 sec) 1 MHz (1 μsec) Channel B only.

Obtain the following test equipment:

HP Model 651B Test Oscillator
HP Model 11048B 50-Ohm Feed-thru Termination
HP Model 180A Oscilloscope
BNC Tee Connector.

a. Connect equipment as shown in Figure B.

Figure B. Connections for Period B Measurements

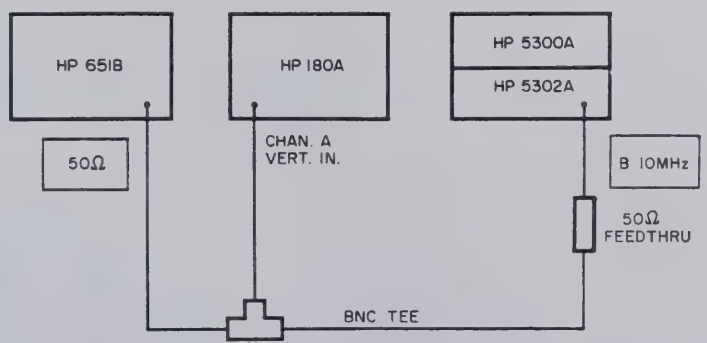


Table 9B-5-1. In-Cabinet Performance Checks (Continued)

b. Set 5302A controls as follows:

1. FUNCTION to PERIOD B.
2. TIME BASE to 1 μs.
3. Channel B Waveform Switch to " ∿ ".
4. Channel B SENSITIVITY to full ccw.

c. Monitor the oscilloscope and set 651B controls for 10 Hz, 100 mV rms output.

d. Adjust 5302A Channel B SENSITIVITY cw for a stable display; display should be approximately 100000 μs, C.

e. Monitor oscilloscope and set 651B for following frequencies: Display should be as listed.

651B	5300A/5302A
10 kHz	000100 μs
100 kHz	000010 μs
1 MHz	000001 μs

NOTE

For increase in resolution, adjust 5302A TIME BASE to .1 μsec.

6. TIME INTERVAL Mode

RANGE: 500 nsec to 1000 seconds.

Obtain the following test equipment:

HP Model 222A Pulse Generator (2 required).
HP Model 11048B 50-Ohm Feed-thru Termination (2 required).
HP Model 180A Oscilloscope.
BNC Tee Connectors, (3 required).

a. Connect equipment as shown in Figure C.

Figure C. Connections for Time Interval Measurements

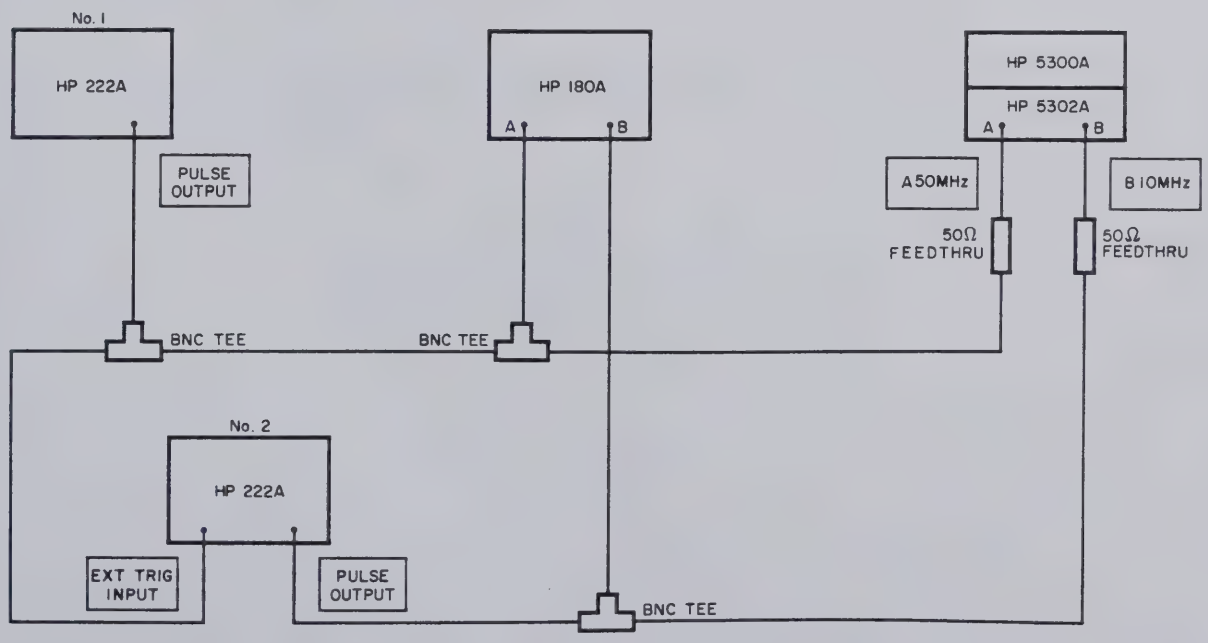


Table 9B-5-1. In-Cabinet Performance Checks (Continued)

b. While monitoring generator No. 1 output with oscilloscope, set No. 1 generator controls as follows:

1. REP RATE to 1k-10k with adjustment centered.
2. PULSE WIDTH for .2 μsec pulse at 5V amplitude.
3. PULSE POLARITY to +.

c. While monitoring generator No. 2 output with oscilloscope, set No. 2 generator controls as follows:

1. REP RATE to MAN/EXT +.
2. PULSE POLARITY to +.
3. PULSE WIDTH for .2 μsec pulse at 5V amplitude.
4. PULSE DELAY for .5 μsec.

d. Set Oscilloscope DISPLAY control to A + B to monitor No. 2 pulse position.

e. Set 5302A controls as follows:

1. SENSITIVITY (both channels) full cw.
2. Waveform switches (both channels) to "⎍".
3. FUNCTION to T.I. A to B.
4. TIME BASE to PERIOD/T.I. .1 μsec.

f. 5302A should display 00000.5 μsec ±1 count; verify time interval with oscilloscope while monitoring oscilloscope.

g. While monitoring oscilloscope, adjust No. 2 generator PULSE DELAY for time intervals from .5 μsec to 150 μsec. 5300A Display should be the same as oscilloscope display.

h. Set No. 1 generator REP RATE to 100-1k and adjustment centered.

i. While monitoring oscilloscope, adjust No. 2 generator PULSE DELAY for time intervals from 150 μsec to 2000 μsec. 5300A display should be the same as oscilloscope display.

j. Set No. 1 generator REP RATE to 10-100 and adjustment full ccw.

k. While monitoring oscilloscope, adjust No. 2 generator PULSE DELAY for time intervals from 2000 μsec to 6000 μsec. 5300A display and oscilloscope display should indicate the same time intervals.

NOTE

Measurement resolution may be adjusted from .1 μsec to 1 msec with the TIME BASE PERIOD/T.I. switch.

Table 9B-5-1. In-Cabinet Performance Checks (Continued)

7. PERIOD AVG B Mode

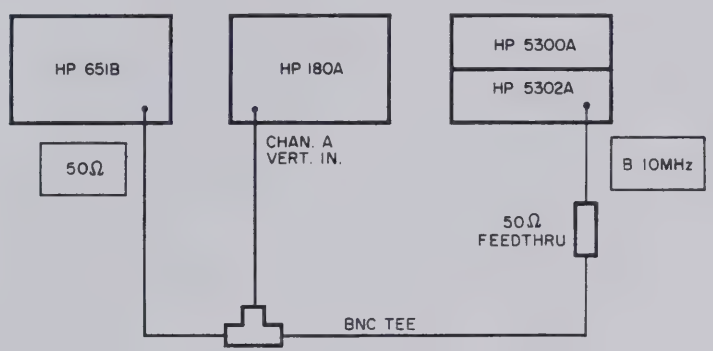
RANGE: 10 Hz (. 1 sec) to 1 MHz (1 μsec).

Obtain the following test equipment:

HP Model 651B Test Oscillator.
HP Model 11048B 50-Ohm Feed-thru Termination.

a. Connect equipment as shown in Figure D.

Figure D. Connections for Period Average Measurements



b. Set 5302A controls as follows:

1. FUNCTION to PER AVG B.
2. Channel B Waveform switch to "∿ ".
3. Channel B SENSITIVITY to full ccw.

c. Monitor the oscilloscope and set 651B controls for 10 Hz, 100 mV rms output.

d. Adjust 5302A Channel B SENSITIVITY cw for a stable display; display should be approximately * 00. 0000 M S C, (* = OVERFLOW) (100 msec).

e. Monitor the oscilloscope and set 651B for the following frequencies; display should be as listed.

651B	5300A/5302A
10 kHz	100. 000 μs C
100 kHz	10. 0000 μs C
1 MHz	01. 0000 μs C

NOTE

Periods averaged automatically selected to provide maximum resolution.

Table 9B-5-1. In-Cabinet Performance Checks (Continued)

8. RATIO Measurements

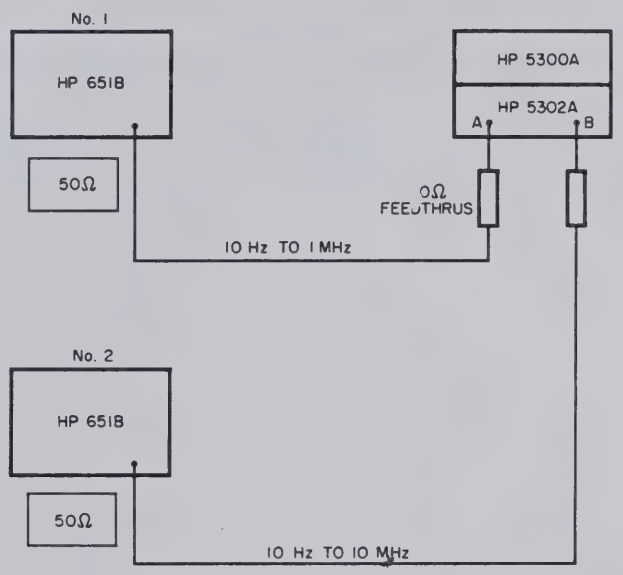
RANGE: Channel A: 10 Hz to 1 MHz.
Channel B: 10 Hz to 10 MHz.

Obtain the following test equipment:

HP Model 651B Test Oscillator (2 required).
HP Model 11048B 50-Ohm Feed-thru Termination (2 required).

a. Connect equipment as shown in Figure E.

Figure E. Ratio Measurement Equipment Connections



b. Set No. 1 oscillator to 10 Hz; verify frequency using Channel B of 5302A.

c. Set No. 2 oscillator to 10 Hz; verify frequency using Channel B of 5302A.

d. Set 5302A controls as follows:

1. Channel A: SENSITIVITY to full cw. Waveform switch to " ∿ ".
2. Channel B: SENSITIVITY to full cw. Waveform switch to " ∿ ".
3. FUNCTION to RATIO $\frac{B}{A}$ X N.
4. TIME BASE to N = 10 (white).

e. 5300A display should be 000010 C; divide display by "N" setting of 10. Ratio is 1:1.

f. Set No. 1 generator to 1 MHz and No. 2 generator to 10 MHz. Display should be 000100 C; divide display by "N" setting of 10. Ratio is 10:1.

NOTE

Ratio Multiplier setting may be set to 10 through 10^7. Measurement time is proportional to N.

Table 9B-5-1. In-Cabinet Performance Checks (Continued)

9. Totalizing (OPEN/CLOSE B) Measurements

Obtain the following test equipment:

HP Model 651B Test Oscillator.
HP Model 11048B 50-Ohm Feed-thru Termination.

a. Connect 651B 50-Ohm output, set to 10 Hz at 100 mV rms, to 5302A Channel B 10 MHz connector.

b. Set Channel B SENSITIVITY full ccw and set Channel B Waveform switch to "∿ ".

c. Set FUNCTION switch to OPEN/CLOSE B.

d. TIME BASE switch may be in any position since it is inoperative in Totalizing mode. Instrument gate is controlled by operator when OPEN/CLOSE B pushbutton is pressed.

e. Press OPEN/CLOSE B switch; 5300A C lamp will turn on; adjust Channel B SENSITIVITY cw until 5300A display starts accumulating.

f. To stop 5300A from accumulating, press OPEN/CLOSE B. To continue accumulation from the number displayed press OPEN/CLOSE B, otherwise press RESET to clear display.

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 5300A/5302A
50 MHz Universal Counter

Test Performed by _____

Serial No. ____ - _____

Date _____

Description	Check
1. CHECK Mode.	
Display is 10 MHz ± 1 Count.	☐
2. FREQ A Mode.	
10 Hz to 50 MHz.	☐
3. FREQ B Mode.	
10 Hz to 10 MHz.	☐
4. PULSE MEASUREMENTS Mode.	
Channel A and B;	
"⊓", "⊔" 10 Hz to 1 MHz Channel A.	☐
"⊓", "⊔" 10 Hz to 1 MHz Channel B.	☐
5. PERIOD B Mode.	
10 Hz (.1 sec) to 1 MHz (1 μsec).	☐
6. TIME INTERVAL Mode.	
500 nsec to 1000 seconds (tested to 6000 μsec).	☐
7. PER AVG B Mode.	
10 Hz (.1 sec) to 1 MHz (1 μsec).	☐
8. RATIO Mode.	
Channel A. 10 Hz to 1 MHz.	☐
Channel B. 10 Hz to 10 MHz.	
9. Totalizing (OPEN/CLOSE B)	
Controlled accumulation.	☐

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 5300A/5302A
50 MHz Universal Counter

Test Performed by _____

Serial No. ____-_____

Date _____

Description	Check
1. CHECK Mode.	
Display is 10 MHz ± 1 Count.	☐
2. FREQ A Mode.	
10 Hz to 50 MHz.	☐
3. FREQ B Mode.	
10 Hz to 10 MHz.	☐
4. PULSE MEASUREMENTS Mode.	
Channel A and B;	
"⊓", "⊔" 10 Hz to 1 MHz Channel A.	☐
"⊓", "⊔" 10 Hz to 1 MHz Channel B.	☐
5. PERIOD B Mode.	
10 Hz (.1 sec) to 1 MHz (1 μsec).	☐
6. TIME INTERVAL Mode.	
500 nsec to 1000 seconds (tested to 6000 μsec).	☐
7. PER AVG B Mode.	
10 Hz (.1 sec) to 1 MHz (1 μsec).	☐
8. RATIO Mode.	
Channel A. 10 Hz to 1 MHz.	☐
Channel B. 10 Hz to 10 MHz.	
9. Totalizing (OPEN/CLOSE B)	
Controlled accumulation.	☐

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

TP1	H	Pulses Low when Time Base switch position "rocked".
TP2	H	Pulses Low when Time Base switch position "rocked".
TP3	H	Pulses Low when Function switch changed to FREQ B.
TP4	H	Goes Low when Function switch changed from FREQ A.
TP5	H	Pulses Low when Time Base switch is "rocked".
TP6	L	Pulses High when Function switch is "rocked".
TP7	L	Pulses High when Function switch is "rocked".
TP8	H (Dim)	Pulsing Low at a .1 second rate. Pulse rate decreases as Time Base switch is changed.
TP9	H	Pulses Low at a .1 second rate. Pulse rate decreases as Time Base switch is changed.
TP10	H	
TP11	L	
TP12	H	

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. Oscillator set to 10 MHz, 100 mVrms/50Ω. See Paragraph 9B-5-16.

SECTION IX B
5302A 50 MHz UNIVERSAL COUNTER
SUBSECTION VI
REPLACEABLE PARTS

9B-6-1. INTRODUCTION

9B-6-2. This subsection contains information for ordering replacement parts. Table 9A-6-1 lists parts used in the HP 5302A. The table lists parts in alpha-numerical order of their reference designators and provides the following information on each part:

a. Hewlett-Packard part number.

b. Description of part (see abbreviations below).

c. Total quantity used in the instrument (the first time the part appears in the list, the total quantity of that part number is printed).

d. Typical manufacturers of the part in a five-digit code (see list of manufacturers in Table 9B-6-2). Manufacturer's part number (miscellaneous parts are listed at the end of Table 9B-6-1).

9B-6-3. ORDERING INFORMATION

9B-6-4. To obtain replacement parts address order or inquiry to your local Hewlett-Packard Sales and Service Office (see lists in Section VI, 5300A manual for addresses). Identify parts by their Hewlett-Packard part number. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

A = assembly	F = fuse	MP - mechanical part	U	integrated circuit			
B = motor	FL = filter	P = plug	V	= vacuum, tube, neon bulb, photocell, etc.			
BT = battery	IC = integrated circuit	Q - transistor					
C = capacitor	J = jack	R - resistor	VR	= voltage regulator			
CP = coupler	K = relay	RT - thermistor	W	- cable			
CR = diode	L = inductor	S - switch	X	- socket			
DL = delay line	LS = loud speaker	T = transformer	Y	= crystal			
DS = device signaling (lamp)	M = meter	TB = terminal board	Z	- tuned cavity, network			
E - misc electronic part	MK = microphone	TP - test point					

ABBREVIATIONS

A = amperes	H = henries	N/O - normally open	RMO - rack mount only				
AFC - automatic frequency control	HDW = hardware	NOM = nominal	RMS - root-mean square				
AMPL = amplifier	HEX = hexagonal	NPO - negative positive zero (zero temperature coefficient)	RWV - reverse working voltage				
	HG = mercury						
BFO = beat frequency oscillator	HR = hour(s)		S-B = slow-blow				
BE CU - beryllium copper	HZ = hertz	NPN - negative-positive-negative	SCR - screw				
BH = binder head			SE = selenium				
BP = bandpass	IF intermediate freq	NRFR = not recommended for field replacement	SECT = section(s)				
BRS = brass	IMPG - impregnated		SEMICON - semiconductor				
BWO = backward wave oscillator	INCD = incandescent	NSR = not separately replaceable	SI - silicon				
	INCL = include(s)		SIL - silver				
CCW - counter-clockwise	INS = insulation(ed)		SL - slide				
CER = ceramic	INT = internal	OBD - order by description	SPG = spring				
CMO = cabinet mount only		OH - oval head	SPL - special				
COEF = coefficient	K = kilo = 1000	OX oxide	SST - stainless steel				
COM = common			SR split ring				
COMP - composition	LH = left hand	P = peak	STL - steel				
COMPL complete	LIN = linear taper	PC = printed circuit					
CONN - connector	LK WASH = lock washer	PF = picofarads = 10^{-12} farads	TA tantalum				
CP - cadmium plate	LOG = logarithmic taper		TD time delay				
CRT = cathode-ray tube	LPF = low pass filter	PH BRZ = phosphor bronze	TGI toggle				
CW = clockwise		PHL - Phillips	THD thread				
	M = milli = 10^{-3}	PIV peak inverse voltage	TI titanium				
DEPC = deposited carbon	MEG = meg = 10^{6}	PNP - positive-negative-positive	TOL - tolerance				
DR = drive	MET FLM = metal film		TRIM - trimmer				
	MET OX = metallic oxide	P/O part of	TWT - traveling wave tube				
ELECT = electrolytic	MFR = manufacturer	POLY - polystyrene					
ENCAP - encapsulated	MHZ = mega hertz	PORC - porcelain	U - micro = 10^{-6}				
EXT = external	MINAT = miniature	POS - position(s)					
	MOM = momentary	POT potentiometer	VAR - variable				
F = farads	MOS = metal ozide substrate	PP - peak-to-peak	VDCW dc working volts				
FH = flat head	MTG = mounting	PT point					
FIL H = fillister head	MY = "mylar"	PWV - peak working voltage	W/ - with				
FXD = fixed			W - watts				
	N - nano (10^{-9})	RECT - rectifier	WIV working inverse voltage				
G - giga (10^{9})	N/C = normally closed	RF - radio frequency					
GE = germanium	NE - neon	RH - round head or right hand	WW - wirewound				
GL = glass	NI PL - nickel plate		W/O - without				
GRD ground(ed)							

01194-14

Table 9B-6-1. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	05302-60001	1	BOARD ASSY: 50 MHz (NOT AVAILABLE FOR FIELD REPLACEMENT OR SALE) (SERIES 1444A)	28480	05302-60001
A1C1	0170-0043	2	C:FXD MY 0.022UF 10% 400VDCW	24446	64FDA223
A1C2	0170-0043		C:FXD MY 0.022UF 10% 400VDCW	24446	64FDA223
A1C3	0140-0192	2	C:FXD MICA 68 PF 5%	28480	0140-0192
A1C4	0140-0192		C:FXD MICA 68 PF 5%	28480	0140-0192
A1C5	0180-0210	4	C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A1C6	0180-0106	5	C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1C7	0180-0228	2	C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A1C8	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1C9	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1C10	0150-0075	8	C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C11	0180-1746	3	C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C12	0180-0210		C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A1C13	0180-0210		C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A1C14	0140-0191	4	C:FXD MICA 56 PF 5% 300VDCW	19701	RDM15E560J 300V
A1C15	0140-0191		C:FXD MICA 56 PF 5% 300VDCW	19701	RDM15E560J 300V
A1C16	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A1C17	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C18	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C19	0160-2197	2	C:FXD MICA 10 PF 5%	28480	0160-2197
A1C20	0160-2197		C:FXD MICA 10 PF 5%	28480	0160-2197
A1C21	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C22	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C23	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C24	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C25	0180-1702	1	C:FXD ELECT 180 UF 20% 6VDCW	56289	150D187X0006R2-DYS
A1C26	0160-2209	1	C:FXD MICA 360 PF 5%	72136	RDM15F361J3C
A1C27	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1C28	0180-0210		C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A1C29	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C30	0180-0106		C: FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1C31	0150-0075		C: FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C32	0150-0075		C: FXD CER 4700 PF +100-20% 500VDCW	72982	951-000-X5U0-472Z
A1CR1	1901-0040		DIODE: SILICON 30MA 30WV	07263	FDG1088
A1CR2	1901-0040		DIODE: SILICON 30MA 30WV	07263	FDG1088
A1CR3	1901-0040		DIODE: SILICON 30MA 30WV	07263	FDG1088
A1CR4	1901-0044	4	DIODE:SILICON 20MA/1V	28480	1901-0044
A1CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR6	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A1CR7	1902-0064	1	DIODE BREAKDOWN:7.5V	28480	1902-0064
A1CR8	1902-3203	2	DIODE BREAKDOWN:SILICON 14.7V 5%	28480	1902-3203
A1CR9	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A1CR10	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A1CR11	1902-3203		DIODE BREAKDOWN:SILICON 14.7V 5%	28480	1902-3203
A1CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR13	1910-0034	1	DIODE:GERMANIUM 25V	28480	1910-0034
A1CR14	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR15	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR16	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1E1	1810-0041	2	R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A1E2	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A1P1	1251-2756	1	CONNECTOR:R & P, 50 CONTACT	74868	57-20500-31
A1Q1	1855-0306	2	TSTR:SI FET	80131	3N128
A1Q2	1855-0306		TSTR:SI FET	80131	3N128
A1Q3	1854-0009	2	TSTR:SI NPN	80131	2N709
A1Q4	1853-0015	1	TSTR:SI PNP	28480	1853-0015
A1Q5	1854-0009		TSTR:SI NPN	80131	2N709
A1R1	0683-1215	4	R:FXD COMP 120 OHM 5% 1/4W	01121	CB 1215
A1R2	0683-1215		R:FXD COMP 120 OHM 5% 1/4W	01121	CB 1215
A1R3	0698-3266	1	R:FXD MET FLM 237K OHM 1% 1/8W	28480	0698-3266
A1R4	0757-0970	1	R:FXD FLM 82K OHM 2% 1/8W	28480	0757-0970
A1R5	0757-0964	2	R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A1R6	0757-0964		R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A1R7	0761-0079	2	R:FXD MET OX 33K OHM 5% 1W	28480	0761-0079
A1R8	0761-0079		R:FXD MET OX 33K OHM 5% 1W	28480	0761-0079
A1R9	0683-1055	2	R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A1R10	0683-1025	2	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A1R11	0683-1055		R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A1R12	0757-0283	4	R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R13	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R14	0683-2025	1	R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A1R15	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W FAC SEL	28480	0757-0283
A1R16	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W FAC SEL	28480	0757-0283
A1R17	0683-1215		R:FXD COMP 120 OHM 5% 1/4W	01121	CB 1215
A1R18	0683-1215		R:FXD COMP 120 OHM 5% 1/4W	01121	CB 1215
A1R19	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025

See introduction to this section for ordering information

Table 9B-6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1R20	0683-4715	3	R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R21	0683-4315	2	R:FXD COMP 430 OHM 5% 1/4W	01121	CB 4315
A1R22	0683-4315		R:FXD COMP 430 OHM 5% 1/4W	01121	CB 4315
A1R23	0698-3114	1	R:FXD COMP 300 OHM 5% 1/8W	28480	0698-3114
A1R24	0683-1625	2	R:FXD COMP 1600 OHM 5% 1/4W	01121	CB 1625
A1R25	0683-1625		R:FXD COMP 1600 OHM 5% 1/4W	01121	CB 1625
A1R26	0698-6984	1	R:FXD COMP 470 OHM 5% 1/8W	28480	0698-6984
A1R27,28,30			LOCATED IN A1E1 AND A1E2		
A1R31 thru			LOCATED IN A1E1 AND A1E2		
A1R44					
A1R29,R32			NOT ASSIGNED		
A1R45	0683-3325	3	R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A1R46	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R47	0683-1035	1	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R48	0683-1505	3	R:FXD COMP 15 OHM 5% 1/4W	01121	CB 1505
A1R49	0683-1505		R:FXD COMP 15 OHM 5% 1/4W	01121	CB 1505
A1R50	0683-0365	1	R:FXD COMP 3.6 OHM 5% 1/4W	01121	CB-36G5
A1R51	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R52	0698-5426	2	R:FXD COMP 10K OHM 10% 1/8W	28480	0698-5426
A1R53	0698-5426		R:FXD COMP 10K OHM 10% 1/8W	28480	0698-5426
A1R54	0683-3325		R: FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A1R55	0683-3325		R: FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A1R56	0683-5135	2	R: FXD COMP 51K OHM 5% 1/4W	01121	CB 5135
A1R57	2100-1738	2	R: VAR COMP FLM 10K OHM LIN. 1/2W	28480	2100-1738
A1R58	0683-5135		R: FXD COMP 51K OHM 5% 1/4W	01121	CB 5135
A1R59	2100-1738		R: VAR COMP FLM 10K OHM LIN 1/2W	28480	2100-1738
A1R60	0675-1021	2	R: FXD COMP 1000 OHM 10% 1/8W	01121	BB1021
A1R61	0683-1505	2	R: FXD COMP 15 OHM 5% 1/4W	01121	CB 1505
A1U1	1820-0307	1	IC: DTL HEX INVERTER	07263	U6A993659X
A1U2	1820-0274	2	IC: DTL QUAD 2-INPUT OR GATE	28480	1820-0274
A1U3	1820-0441		IC: DUAL 5-INPUT NAND GATE	04713	SC8171PK
A1U4	1820-0441		IC:DUAL 5-INPUT NAND GATE	04713	SC8171PK
A1U5	1820-0054	2	IC:TTL QUAD 2-INPUT NAND GATE	01295	SN4342
A1U6	1820-0511	2	IC:TTL QUAD 2-INPT & GATE	01295	SN20572
A1U7	1820-0281	1	IC:DIGITAL DUAL J-K MASTER SLAVE F/F	28480	1820-0281
A1U8	1820-0253	2	INTEGRATED CIRCUIT:DIGITAL ECL DUAL	04713	MC1035P
A1U9	1820-0094	1	IC:DTL QUAD 2-INPUT NAND NOR GATE	07263	U6A994659X
A1U10	1820-0174	2	INTEGRATED CIRCUIT:TTL HEX INVERTER	01295	SN8199
A1U11	1820-0084	1	INTEGRATED CIRCUIT:TTL	28480	1820-0084
A1U12	1820-0590	1	IC:DIGITAL TTL DUAL 2-WIDE,INPT AND/OR	28480	1820-0590
A1U13	1820-0253		INTEGRATED CIRCUIT:DIGITAL ECL DUAL	04713	MC1035P
A1U14	1820-0577	1	IC:DIGITAL TTL HEX INVERTER	01295	SN22729
A1U15	1820-0205	1	IC:TTL QUAD 2-INPT OR GATE	28480	MC3003P
A1U16	1820-0380	1	IC:TTL 4-WIDE INVERT GATE	01295	SN4488
A1U17	1820-0351	1	IC:DIGITAL DTL TRIPLE 3-INPT NAND GATE	28480	1820-0351
A1U18	1820-0581	2	IC:DIGITAL ECL DUAL AC-COUPLED J-K/F-F	28480	1820-0581
A1U19	1820-0581		IC:DIGITAL ECL DUAL AC-COUPLED J-K/F-F	28480	1820-0581
A1U20	1820-0511		IC:TTL QUAD 2-INPT & GATE	01295	SN20572
A1U21	1820-0077	2	IC:TTL DUAL D FF (LATCH)	01295	SN4354
A1U22	1820-0077		IC:TTL DUAL D FF (LATCH)	01295	SN4354
A1U23	1820-0072	1	INTEGRATED CIRCUIT:TTL	01295	SN4347
A1U24	1820-0174		INTEGRATED CIRCUIT:TTL HEX INVERTER	01295	SN8199
A1U25	1820-0054		INTEGRATED CIRCUIT:ECL-TTL TRANSLATOR	01295	SN4342
A1U26	1820-1052	1	IC:TTL QUAD 2-INPUT OR GATE	04713	SC 7023PK
A1U27	1820-0694	1	IC:TTL 2-INPT OR GATE	01295	SN 74S86
A1XU8, 13	1200-0474		SOCKET:IC	28480	1200-0474
J1	1250-0001	3	CONNECTOR:BNC	02660	
J2	1250-0001		CONNECTOR:BNC	02660	
J3	1250-0001		CONNECTOR:BNC	02660	
R1	2100-3075	2	R:VAR COMP 1K OHM 20% 1/4W	28480	2100-3075
R2	2100-3075		R:VAR COMP 1K OHM 20% 1/4W	28480	2100-3075
S1	3101-1599	2	SWITCH:SLIDE DP3T 0.5A 125V AC/DC	28480	3101-1599
S2	3100-2920	1	SWITCH:ROTARY	28480	3100-2920
S3	3100-2921	1	SWITCH:ROTARY	28480	3100-2921
S4	3101-1159	1	SWITCH:PUSHBUTTON SPDT	82389	10S-1051
S5	3101-1327		SWITCH:SLIDE DP3T 0.5A 125V AC/DC	79727	G128S-0006
W1	05302-60003	1	CABLE ASSY:MAIN INCLUDES S2, S3	28480	05302-60003
W2	05302-60004	1	CABLE ASSY:SENSITIVITY CHAN A (R1) 5-1/2" LG	28480	05302-60004
W3	05302-60005	1	CABLE ASSY: 50 MHZ, (J1), 5-1/2" LONG	28480	05302-60005

See introduction to this section for ordering information

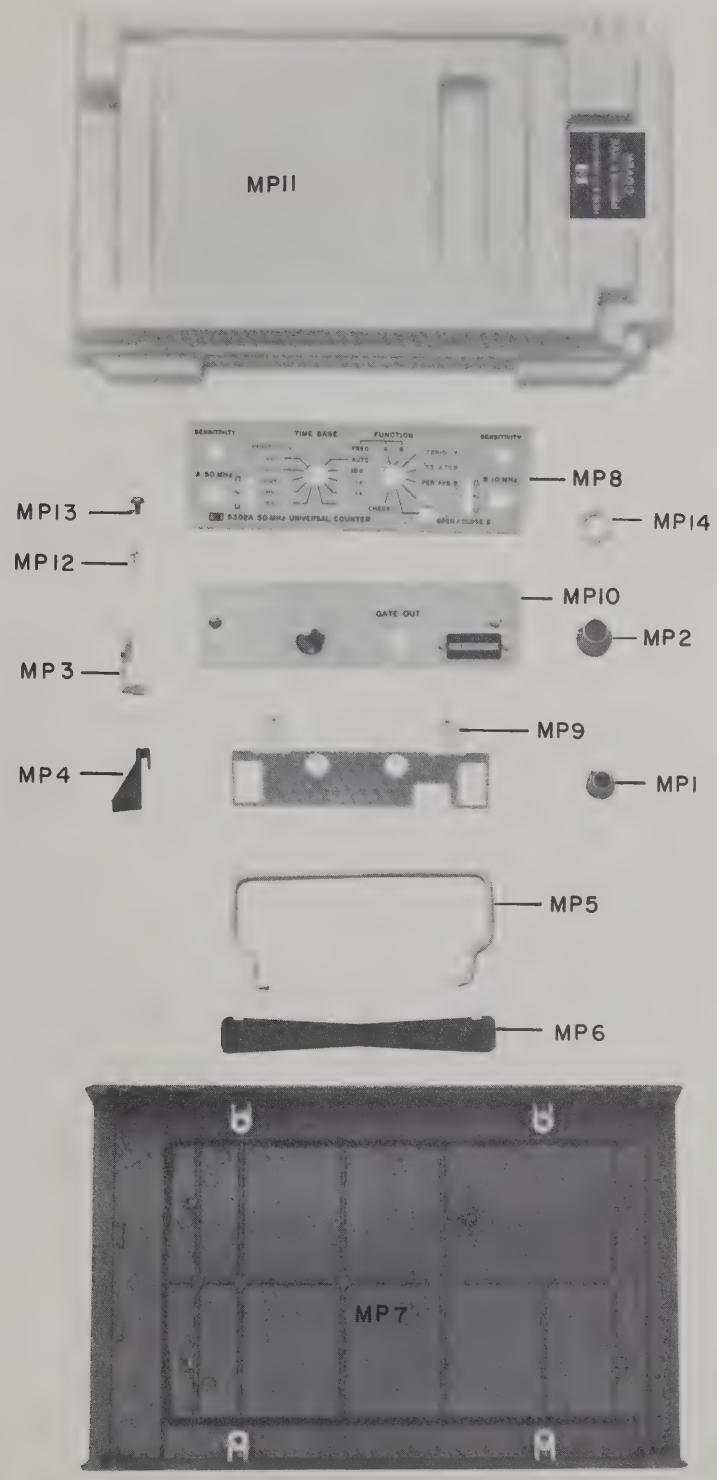
Table 9B-6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS & MISCELLANEOUS PARTS		
MP1	0370-1005	2	KNOB: JADE GREY	28480	0370-1005
MP2	0370-1099	2	KNOB: JADE GREY	28480	0370-1099
MP3	05300-40003	4	SUPPORT: BOARD	28480	05300-40003
MP4	05300-40004	4	GUIDE: SLIDE	28480	05300-40004
MP5	05301-20005	1	STAND: TILT	28480	05301-20005
MP6	5040-7032	2	FOOT: REAR	28480	5040-7032
MP7	05300-20010	1	CASE: ALUMINUM, CAST	28480	05300-20010
MP8	05302-00001	1	PANEL: FRONT	28480	05302-00001
MP9	05302-00002	1	BRACKET: FRONT	28480	05302-00002
MP10	05302-00004	1	PANEL: REAR	28480	05302-00004
MP11	05300-80004	1	DUST COVER	28480	05300-80004
	8120-0026	1	CABLE: RF 100 OHM 13" LONG, USED IN MAKING W2 AND W3	28480	8120-0026
	8120-0097	1	CABLE: 2-CONDUCTOR SHIELDED 2X#26AWG, 12" LONG, USED IN MAKING PART OF W1	28480	8120-0097
MP12	0624-0208	8	SCREW: SELF-TAPPING, CAD-PLATE POSIDRIV 6/32 X 1/2"	28480	0624-0208
MP13	2360-0111	2	SCREW: PAN HEAD SS POSIDRIVE 6/32" x 3/16"	28480	2360-0111
MP14	3050-0391	2	WASHER: BRASS .385 I.D.; .625 O.D.; .015 THK; NI PLATE	28480	3050-0391
	1460-1311	1	SPRING: LEAF	28480	1460-1311
	1460-1312	1	SPRING: LEAF	28480	1460-1312

Table 9B-6-2. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.	53204
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
02660	AMPHENOL CORP.	BROADVIEW, ILL.	60153
04713	MOTOROLA SEMICONDUCTOR PROD. INC.	PHOENIX, ARIZ.	85008
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
19701	ELECTRA/MIDLAND CORP.	MINERAL WELLS, TEX.	76067
28480	HEWLETT-PACKARD COMPANY	PALO ALTO, CALIF.	94304
29604	STACKPOLE COMPONENTS CO.	RALEIGH, N.C.	27610
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
74868	AMPHENOL CORP. RF DIV.	DANBURY, CONN.	06810
79727	CONTINENTAL-WIRT ELECTRONICS CORP.	PHILADELPHIA, PA.	19144
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON, D.C.	20006
82389	SWITCHCRAFT INC.	CHICAGO, ILL.	60630

Figure 9B-6-1. Mechanical Parts Location



SECTION IX B

5302A UNIVERSAL COUNTER
SUBSECTION VII
MANUAL CHANGES AND OPTIONS

9B-7-1. MANUAL CHANGES

9B-7-2. Section IX B applies directly to Model 5302A Universal Counters having serial prefix number 1444A.

9B-7-3. NEWER INSTRUMENTS

9B-7-4. As changes are made, newer instruments may have serial prefix numbers not listed in Section IX B. The manuals for these instruments will be supplied with "manual changes" sheets containing the required information; replace the affected pages with the "replacement manual changes" pages. Contact the nearest Hewlett-Packard Sales and Service office for information if this sheet is missing.

9B-7-5. OLDER INSTRUMENTS

9B-7-6. Older instruments have serial number prefixes of 1112A and 1332A. Pages 9B-7-3 through 9B-7-6 apply directly to instruments with Serial Prefix 1112A.

9B-7-7. Serial Prefix 1332A instruments use a HP Part No. 1820-0694 (SN74S86N) quad 2-input exclusive OR gate for A1U27 in place of HP Part No. 1820-0282. The faster 1820-0282 exclusive OR gate is recommended for replacement in Series Prefix 1112A instruments.

9B-7-8. In Tables on pages 9B-7-4 and 9B-7-6, change A1U27 from 1820-0282 to 1820-0694 (Manufacturer Part No. SN74S86N) for Prefix 1332A instruments or 1112A instruments in which the 1820-0694 integrated circuit has been installed as A1U27.

9B-7-9. Correct Tables on pages 9B-7-4 and 9B-7-6 by changing A1U15 from 1820-0661 to 1820-0205 (Mfr. Part No. MC3003).

9B-7-10. OPTIONS

9B-7-11. No options at time of printing.

Table 9B-7-1. Replaceable Parts (Serial Prefix 1112A or 1332A)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	05302-60001	1	BOARD ASSY: 50 MHz (NOT AVAILABLE FOR FIELD REPLACEMENT OR SALE)	28480	05302-60001
A1C1	0170-0043	2	C:FXD MY 0.022UF 10% 400VDCW	28480	0170-0043
A1C2	0170-0043		C:FXD MY 0.022UF 10% 400VDCW	28480	0170-0043
A1C3	0140-0192	2	C:FXD MICA 68 PF 5%	28480	0140-0192
A1C4	0140-0192		C:FXD MICA 68 PF 5%	28480	0140-0192
A1C5	0180-0210	4	C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A1C6	0180-0106	5	C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1C7	0180-0228	2	C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A1C8	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1C9	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1C10	0150-0075	7	C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C11	0180-1746	3	C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C12	0180-0210		C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A1C13	0180-0210		C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A1C14	0140-0191	4	C:FXD MICA 56 PF 5% 300VDCW	19701	RDM15E560J 300V
A1C15	0140-0191		C:FXD MICA 56 PF 5% 300VDCW	19701	RDM15E560J 300V
A1C16	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A1C17	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C18	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C19	0160-2197	2	C:FXD MICA 10 PF 5%	28480	0160-2197
A1C20	0160-2197		C:FXD MICA 10 PF 5%	28480	0160-2197
A1C21	0180-1746		C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C22	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C23	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C24	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C25	0180-1702	1	C:FXD ELECT 180 UF 20% 6VDCW	56289	150D187X0006R2-DYS
A1C26	0160-2209	1	C:FXD MICA 360 PF 5%	72136	RDM15F361J3C
A1C27	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1C28	0180-0210		C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A1C29	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C30	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A1C31	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1CR1	1901-0040	8	DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR3	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR4	1901-0044	4	DIODE:SILICON 20MA/1V	28480	1901-0044
A1CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR6	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A1CR7	1902-0064	1	DIODE BREAKDOWN:7.5V	28480	1902-0064
A1CR8	1902-3203	2	DIODE BREAKDOWN:SILICON 14.7V 5%	28480	1902-3203
A1CR9	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A1CR10	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A1CR11	1902-3203		DIODE BREAKDOWN:SILICON 14.7V 5%	28480	1902-3203
A1CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR13	1910-0034	1	DIODE:GERMANIUM 25V	28480	1910-0034
A1CR14	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR15	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR16	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1E1	1810-0041	2	R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A1E2	1810-0041		R:NETWORK,8 RES. 2.7K OHM 5%	28480	1810-0041
A1P1	1251-2756	1	CONNECTOR:R & P, 50 CONTACT	74868	57-20500-31
A1Q1	1855-0306	2	TSTR:SI FET	80131	3N128
A1Q2	1855-0306		TSTR:SI FET	80131	3N128
A1Q3	1854-0009	2	TSTR:SI NPN	80131	2N709
A1Q4	1853-0015	1	TSTR:SI PNP	28480	1853-0015
A1Q5	1854-0009		TSTR:SI NPN	80131	2N709
A1R1	0683-1215	4	R:FXD COMP 120 OHM 5% 1/4W	01121	CB 1215
A1R2	0683-1215		R:FXD COMP 120 OHM 5% 1/4W	01121	CB 1215
A1R3	0698-3266	1	R:FXD MET FLM 237K OHM 1% 1/8W	28480	0698-3266
A1R4	0757-0970	1	R:FXD FLM 82K OHM 2% 1/8W	28480	0757-0970
A1R5	0757-0964	2	R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A1R6	0757-0964		R:FXD FLM 47K OHM 2% 1/8W	28480	0757-0964
A1R7	0761-0079	2	R:FXD MET OX 33K OHM 5% 1W	28480	0761-0079
A1R8	0761-0079		R:FXD MET OX 33K OHM 5% 1W	28480	0761-0079
A1R9	0683-1055	2	R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A1R10	0683-1025	2	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A1R11	0683-1055		R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A1R12	0757-0283	4	R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R13	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
A1R14	0683-2025	1	R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A1R15	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W FAC SEL	28480	0757-0283
A1R16	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W FAC SEL	28480	0757-0283
A1R17	0683-1215		R:FXD COMP 120 OHM 5% 1/4W	01121	CB 1215
A1R18	0683-1215		R:FXD COMP 120 OHM 5% 1/4W	01121	CB 1215
A1R19	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025

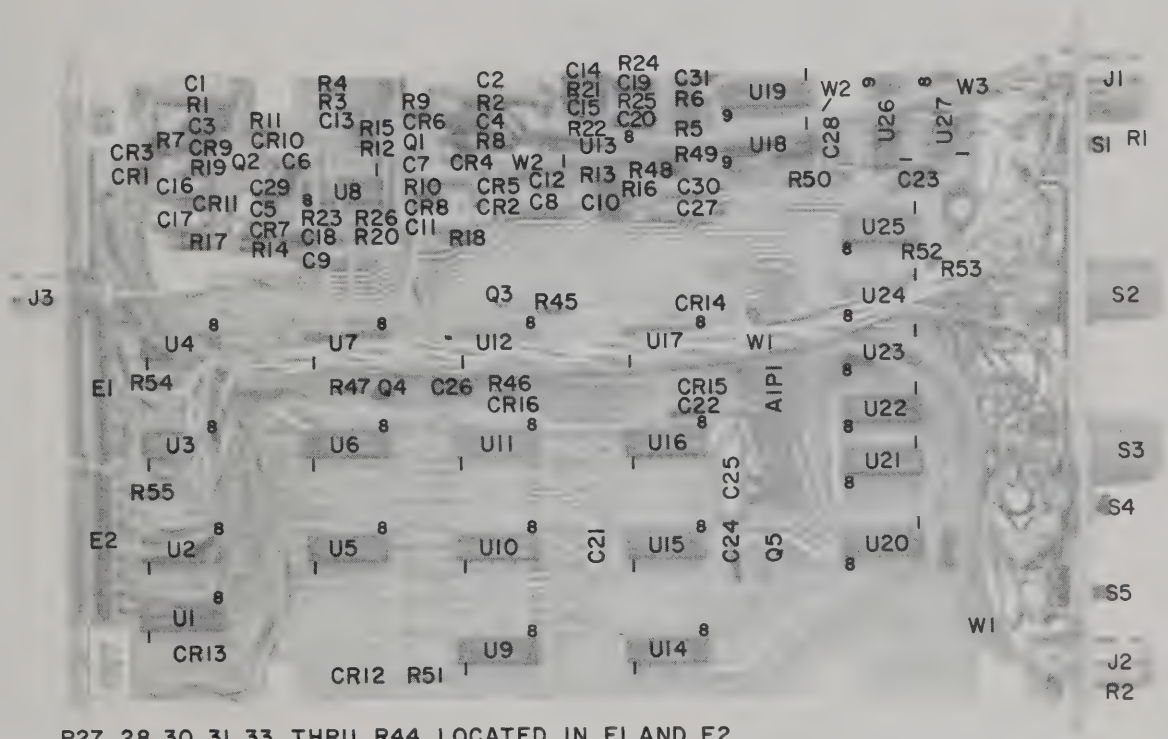
See introduction to this section for ordering information

Table 9B-7-1. Replaceable Parts (Serial Prefix 1112A or 1332A) (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1R20	0683-4715	3	R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R21	0683-4315	2	R:FXD COMP 430 OHM 5% 1/4W	01121	CB 4315
A1R22	0683-4315		R:FXD COMP 430 OHM 5% 1/4W	01121	CB 4315
A1R23	0698-3114	1	R:FXD COMP 300 OHM 5% 1/8W	28480	0698-3114
A1R24	0683-1625	2	R:FXD COMP 1600 OHM 5% 1/4W	01121	CB 1625
A1R25	0683-1625		R:FXD COMP 1600 OHM 5% 1/4W	01121	CB 1625
A1R26	0698-6984	1	R:FXD COMP 470 OHM 5% 1/8W	28480	0698-6984
A1R27, 28, 30			LOCATED IN A1E1 and A1E2		
A1R31 thru A1R44			LOCATED IN A1E1 and A1E2		
A1R29, R32			NOT ASSIGNED		
A1R45	0683-3325	3	R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A1R46	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R47	0683-1035	1	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R48	0683-1505	2	R:FXD COMP 15 OHM 5% 1/4W	01121	CB 1505
A1R49	0683-1505		R:FXD COMP 15 OHM 5% 1/4W	01121	CB 1505
A1R50	0683-0365	1	R:FXD COMP 3.6 OHM 5% 1/4W	01121	CB-3605
A1R51	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R52	0698-5426	2	R:FXD COMP 10K OHM 10% 1/8W	28480	0698-5426
A1R53	0698-5426		R:FXD COMP 10K OHM 10% 1/8W	28480	0698-5426
A1R54	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A1R55	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A1U1	1820-0307	1	IC:DTL HEX INVERTER	07263	U6A993659X
A1U2	1820-0274	1	IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A1U3	1820-0441	2	IC:DUAL 5-INPUT NAND GATE	04713	SC8171PK
A1U4	1820-0441		IC:DUAL 5-INPUT NAND GATE	04713	SC8171PK
A1U5	1820-0054	2	IC:TTL QUAD 2-INPUT NAND GATE	01295	SN4342
A1U6	1820-0511	2	IC:TTL QUAD 2-INPT & GATE	01295	SN20572
A1U7	1820-0281	1	IC:DIGITAL DUAL J-K MASTER SLAVE F/F	28480	1820-0281
A1U8	1820-0253	2	INTEGRATED CIRCUIT:DIGITAL ECL DUAL	04713	MC1035P
A1U9	1820-0094	1	IC:DTL QUAD 2-INPUT NAND NOR GATE	07263	U6A994659X
A1U10	1820-0174	2	INTEGRATED CIRCUIT:TTL HEX INVERTER	01295	SN8199
A1U11	1820-0084	1	INTEGRATED CIRCUIT:TTL	28480	1820-0084
A1U12	1820-0590	1	IC:DIGITAL TTL DUAL 2-WIDE, INPT AND/OR	28480	1820-0590
A1U13	1820-0253		INTEGRATED CIRCUIT:DIGITAL ECL DUAL	04713	MC1035P
A1U14	1820-0577	1	IC:DIGITAL TTL HEX INVERTER	01295	SN22729
A1U15	1820-0661	1	IC:TTL QUAD 2-INPT OR GATE (Preferred part)	28480	SN-7432N
A1U16	1820-0380	1	IC:TTL 4-WIDE INVERT GATE	01295	SN4488
A1U17	1820-0351	1	IC:DIGITAL DTL TRIPLE 3-INPT NAND GATE	28480	1820-0351
A1U18	1820-0581	2	IC:DIGITAL ECL DUAL AC-COUPLED J-K/F-F	28480	1820-0581
A1U19	1820-0581		IC:DIGITAL ECL DUAL AC-COUPLED J-K/F-F	28480	1820-0581
A1U20	1820-0511		IC:TTL QUAD 2-INPT & GATE	01295	SN20572
A1U21	1820-0077	2	IC:TTL DUAL D FF (LATCH)	01295	SN4354
A1U22	1820-0077		IC:TTL DUAL D FF (LATCH)	01295	SN4354
A1U23	1820-0072	1	INTEGRATED CIRCUIT:TTL	01295	SN4347
A1U24	1820-0174		INTEGRATED CIRCUIT:TTL HEX INVERTER	01295	SN8199
A1U25	1820-0054		IC:TTL QUAD 2-INPUT NAND GATE	01295	SN4342
A1U26	1820-0275	1	INTEGRATED CIRCUIT:DIGITAL	04713	SC 7023PK
A1U27	1820-0282	1	IC:TTL 2-INPT OR GATE	01295	SN13603
A1XU8,13	1200-0474		SOCKET:IC	28480	1200-0474
J1	1250-0001	3	CONNECTOR:BNC	02660	
J2	1250-0001		CONNECTOR:BNC	02660	
J3	1250-0001		CONNECTOR:BNC	02660	
R1	2100-3075	2	R:VAR COMP 1K OHM 20% 1/4W	28480	2100-3075
R2	2100-3075		R:VAR COMP 1K OHM 20% 1/4W	28480	2100-3075
S1	3101-1599	2	SWITCH:SLIDE DP3T 0.5A 125V AC/DC	28480	3101-1599
S2	3100-2920	1	SWITCH:ROTARY	28480	3100-2920
S3	3100-2921	1	SWITCH:ROTARY	28480	3100-2921
S4	3101-1159	1	SWITCH:PUSHBUTTON SPDT	82389	10S-1051
S5	3101-1327		SWITCH:SLIDE DP3T 0.5A 125V AC/DC	79727	G128S-0006
W1	05302-60003	1	CABLE ASSY:MAIN INCLUDES S2, S3	28480	05302-60003
W2	05302-60004	1	CABLE ASSY:SENSITIVITY CHAN A (R1)5-1/2"LG	28480	05302-60004
W3	05302-60005	1	CABLE ASSY:50 MHZ, (J1), 5-1/2" LONG	28480	05302-60005
			CHASSIS & MISCELLANEOUS PARTS		
MP1	0370-1005	2	KNOB:JADE GREY	28480	0370-1005
MP2	0370-1099	2	KNOB:JADE GREY	28480	0370-1099
MP3	05300-40003	4	SUPPORT:BOARD	28480	05300-40003
MP4	05300-40004	4	GUIDE:SLIDE	28480	05300-40004
MP5	05301-20005	1	STAND:TILT	28480	05301-20005
MP6	5040-7032	2	FOOT: REAR	28480	5040-7032
MP7	05300-20010	1	CASE: ALUMINUM, CAST	28480	05300-20010
MP8	05302-00001	1	PANEL:FRONT	28480	05302-00001
MP9	05302-00002	1	BRACKET:FRONT	28480	05302-00002
MP10	05302-00004	1	PANEL:REAR	28480	05302-00004
MP11	05300-80004	1	DUST COVER	28480	05300-80004
	8120-0026	1	CABLE:RF 100 OHM 13"LONG, USED IN MAKING W2 AND W3	28480	8120-0026
	8120-0097	1	CABLE:2-CONDUCTOR SHIELDED 2X#26AWG, 12" LONG, USED IN MAKING PART OF W1	28480	8120-0097
MP12	0624-0208	8	SCREW:SELF-TAPPING, CAD-PLATE POSI-DRIV 6/32 X 1/2"	28480	0624-0208
MP13	2360-0111	2	SCREW:PAN HEAD SS POSIDRIV 6/32" x 3/16"		
MP14	3050-0391	2	WASHER:BRASS .385 I.D.; .625 O.D.; .015 THK; NI PLATE		

See introduction to this section for ordering information

Figure 9B-7-1. A1 Component Locator (Series 1112A or 1332A)



R27, 28, 30, 31, 33, THRU R44 LOCATED IN E1 AND E2

Part of Figure 9B-7-2. A1 50 MHz Board Assembly (Series Prefix 1112A or 1332A)

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
 RESISTANCE IN OHMS;
 CAPACITANCE IN PICOFARADS.
3. ASTERISK (*) INDICATES FACTORY SELECTED VALUE. TYPICAL VALUE SHOWN.

REFERENCE DESIGNATIONS

NO PREFIX	A1
	C1-31
	CR1-16
	Q1-5
J1-3	P1
R1,2	R1-28,30, 31, 33-55
S1-5	U1-27

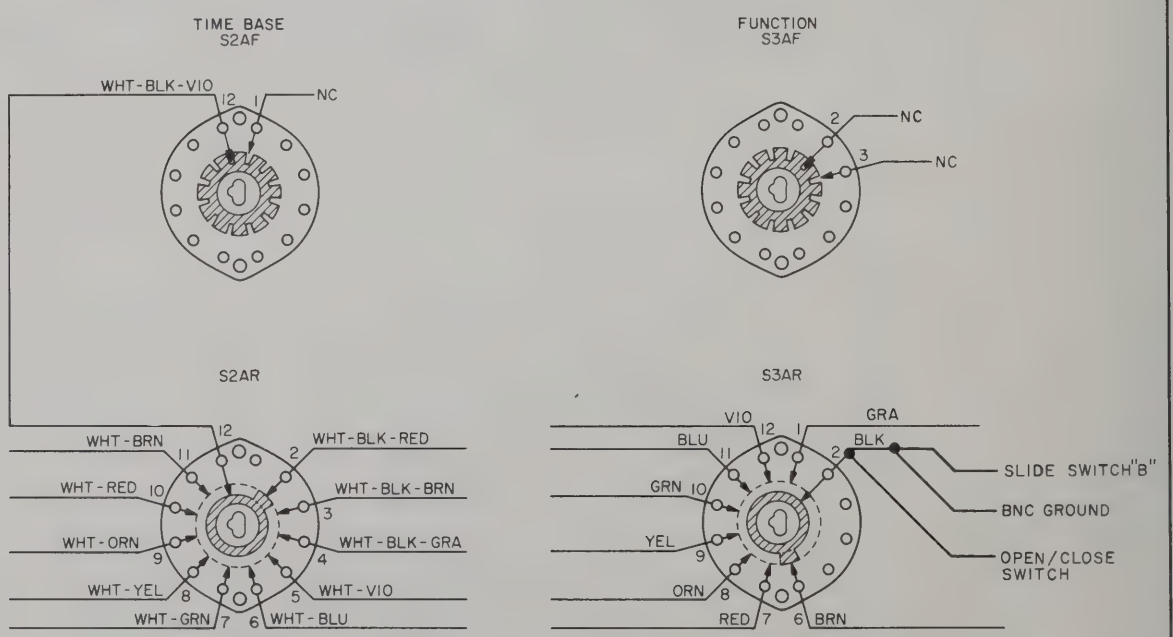
R29,32 NOT ASSIGNED.

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,2,3,5,12, 14,15,16	1901-0040
CR4,6,9,10	1901-0044
CR7	1902-0064
CR8,11	1902-3203
CR13	1910-0034
Q1,2	1855-0306
Q3,5	1854-0009
Q4	1853-0015
U1	1820-0307
U2	1820-0274
U3,4	1820-0441
U5,25	1820-0054
U6,20	1820-0511
U7	1820-0281

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
U8,13	1820-0253
U9	1820-0094
U10,24	1820-0174
U11	1820-0084
U12	1820-0590
U14	1820-0577
U15	1820-0661
U16	1820-0380
U17	1820-0351
U18,19	1820-0581
U21,22	1820-0077
U23	1820-0072
U26	1820-0275
U27	1820-0282



1. TIME BASE SWITCH (S2) SHOWN IN AUTO POSITION. DIRECTION OF TRAVEL IS CW.
2. FUNCTION SWITCH SHOWN IN FREQ. "A" POSITION. DIRECTION OF TRAVEL IS CW.

SECTION IX B
5302A 50 MHz UNIVERSAL COUNTER
SUBSECTION VIII
CIRCUIT DIAGRAMS

9B-8-1. GENERAL

9B-8-2. Subsection VIII contains:

a. Schematic diagram notes contained in Section VIII of the 5300A.

b. Instrument interconnection pin list of signals listing where they originate and where they go.

c. Component locators and circuit diagrams of assemblies.

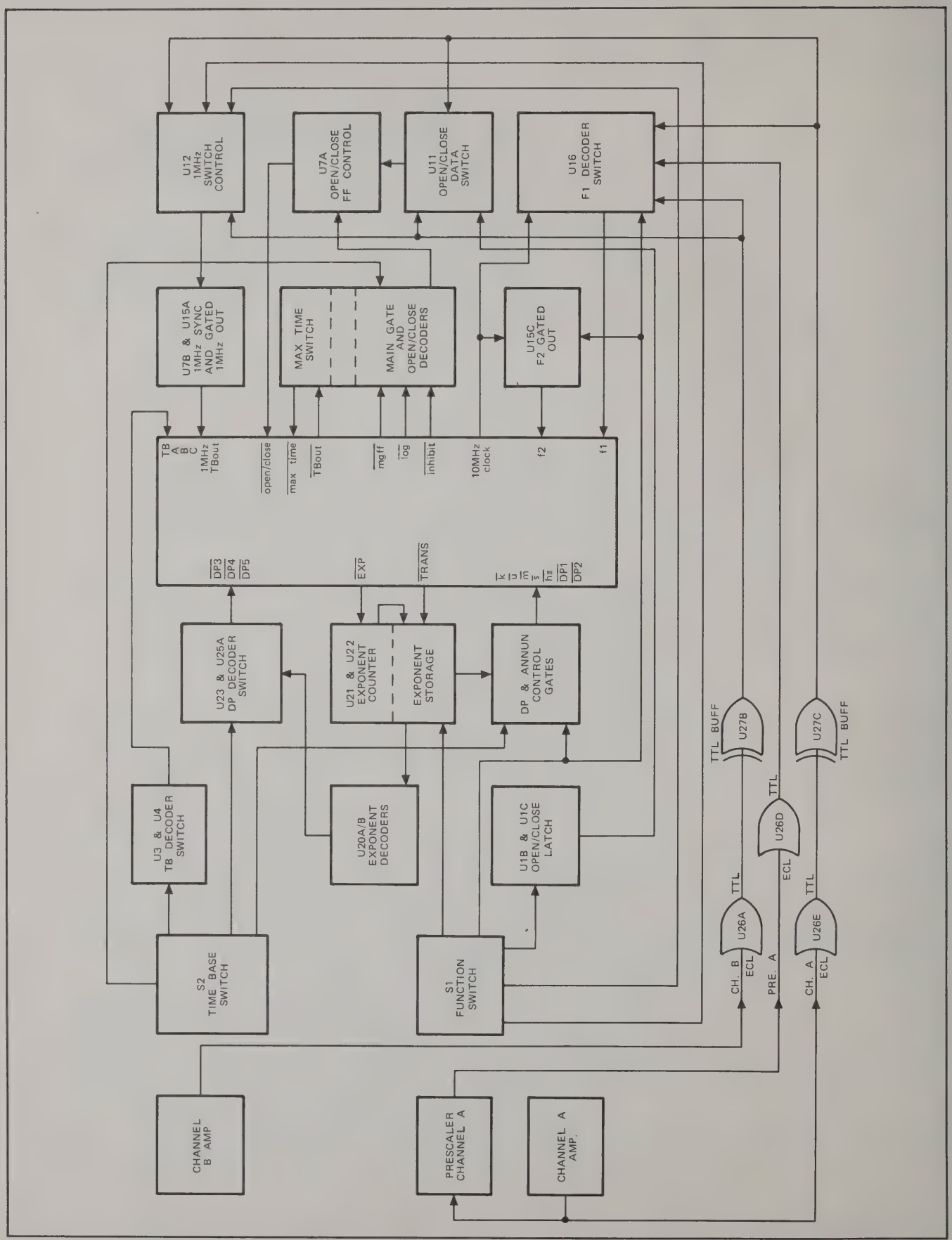
Table 9B-8-1. Instrument Interconnection List

PIN NO.	SIGNAL NAME	DESCRIPTION
1	+5 V	Input DC from 5300A
2	-5 V	
3	NO CONNECTION	
4	GROUND	Ground
5 *	F1	Signal to be accumulated in the counter after gating by the control circuit.
6	"$\overline{9}$"	Goes low when the counter reaches 9% full scale.
7 *	F2	Input signal to the time base gated by the control circuit.
8	$\overline{\text{INHIBIT}}$	High during the measurement cycle, low during the display cycle.
9 *	$\overline{\text{OPEN}}$	Low signal forces the main gate flip-flop to the open position.
10 *	$\overline{\text{CLOSE}}$	Low signal forces the main gate flip-flop to the close position.
11	$\overline{\text{LOG}}$	Logarithmic output pulse train from time base triggers main gate flip-flop on rising edge.
12	$\overline{\text{MGFF}}$	Main gate flip-flop signal is low when gate is open.
13	$\overline{\text{EXPONENT}}$	Inverted log pulses while main gate is open indicates number of auto-ranging steps.
14	NO CONNECTION	
15	RESET	High signal resets all registers.
16	CLOCK	10 MHz reference signal from crystal oscillator
17 *	$\overline{\text{MAX TIME}}$	Low signal enables closing of the gate on next log pulse. Rising edge initiates display cycle.
18	TIME BASE OUTPUT	Output from the time base decade position selected by the time base select code on pins 22, 23, and 24.
19 *	$\overline{\text{PRINT}}$	Low signal provides print command to rear panel connector.
20	$\overline{\text{TRANSFER}}$	Low signal transfers data to display. High signal stores data.
21 *	1 MHz TIME BASE INPUT	Input direct from plug-on bypasses control circuit.
22 *	TIME BASE SELECT A	Time base select code A, B, and C selects the time base division factor of the signal at the time base output at pin 18.
23 *	TIME BASE SELECT B	
24 *	TIME BASE SELECT C	
25 ◄ 50 ◄	+22 V Interconnection	Full wave rectified voltage from the power transformer secondary. Provides power to charge the battery pack. If no battery pack is used, pin 25 is connected via the plug-on to pin 50 (DC-IN).
26	+17 V	
27 *	$\overline{\text{Hz}}$	Pins 27 through 31 provide the drive to the annunciator lights on the front panel. A low signal lights the corresponding indicator.
28 *	$\overline{\text{M}}$	
29 *	$\overline{\text{S}}$	
30 *	$\overline{\text{K}}$	
31 *	$\overline{\mu}$	
32	$\overline{\text{MANUAL RESET}}$	Low signal from front panel pushbutton switch or rear panel input clears the system to zero.
33 *	$\overline{\text{DP1}}$	Low signal activates decimal point 1.

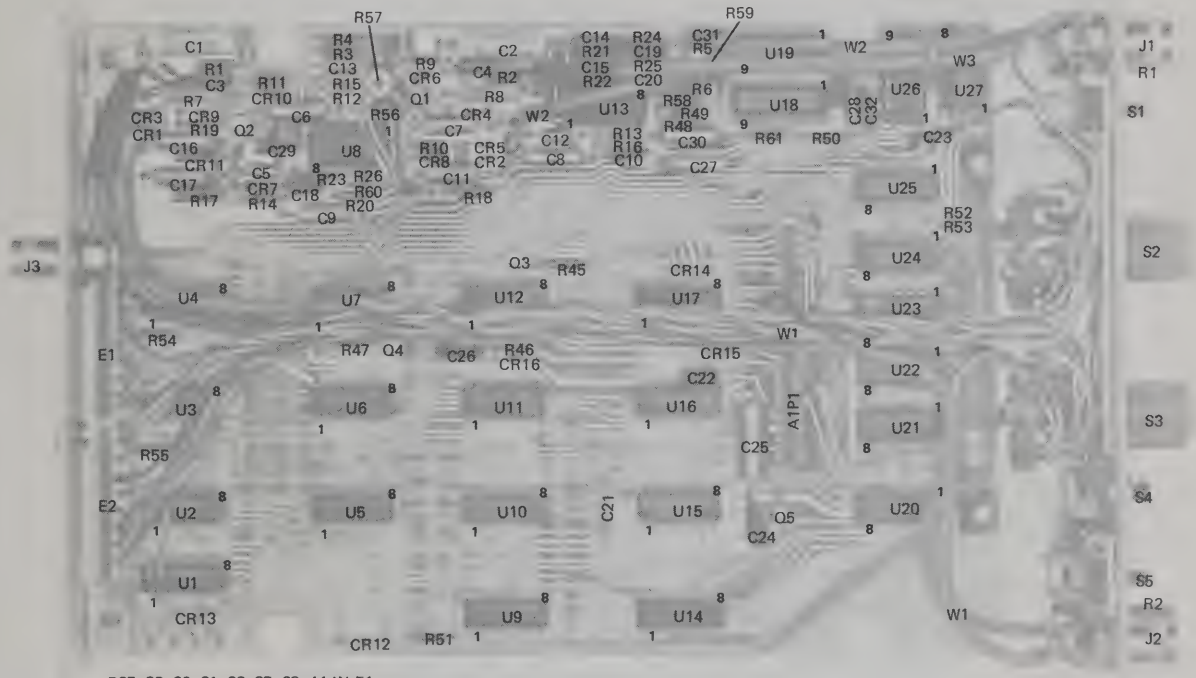
Table 9B-8-1. Instrument Interconnection List (Cont'd)

PIN NO.	SIGNAL NAME	DESCRIPTION
34 *	$\overline{DP2}$	Low signal activates decimal point 2.
35	RIGHT/LEFT	Code indicating half character which is being addressed. High when right-hand half of character is displayed.
36	DIGIT ADDRESS X	Digit address code X, Y, Z from the display scanner indicates a digit being displayed.
37	DIGIT SELECT X	
38	DIGIT ADDRESS Y	
39	DIGIT SELECT Y	Digit select code X, Y, Z is the corresponding code which selects the digit at the output of the counter. If the mainframe counter is displayed directly the corresponding lines of the digit address code and the digit select code are connected together.
40	DIGIT ADDRESS Z	
41	NO CONNECTION	
42	NO CONNECTION	
43	NO CONNECTION	
44	NO CONNECTION	
45	NO CONNECTION	
46 *	$\overline{DP3}$	Low signal activates decimal point 3.
47 *	$\overline{DP4}$	Low signal activates decimal point 4.
48 *	$\overline{DP5}$	Low signal activates decimal point 5.
49	NO CONNECTION	Ground
50	DC IN Interconnection	DC power to power supply from battery pack or from 22 volt input power from pin 25.
25		

Part of Figure 9B-8-1. A1 50 MHz Assembly Block Diagram



Part of Figure 9B-8-1. A1 Component Locator



R27, 28, 30, 31, 33, 37, 38, 44 IN E1
R34–36, 39–43 IN E2

Part of Figure 9B-8-1. A1 50 MHz Board Assembly Series 1444A

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS.
3. ASTERISK (*) INDICATES FACTORY SELECTED VALUE. TYPICAL VALUE SHOWN.

REFERENCE DESIGNATIONS

NO PREFIX	A1
	C1-32
	CR1-16
	Q1-5
J1-3	P1
R1,2	R1-28,30, 31,33-61
S1-5	U1-27

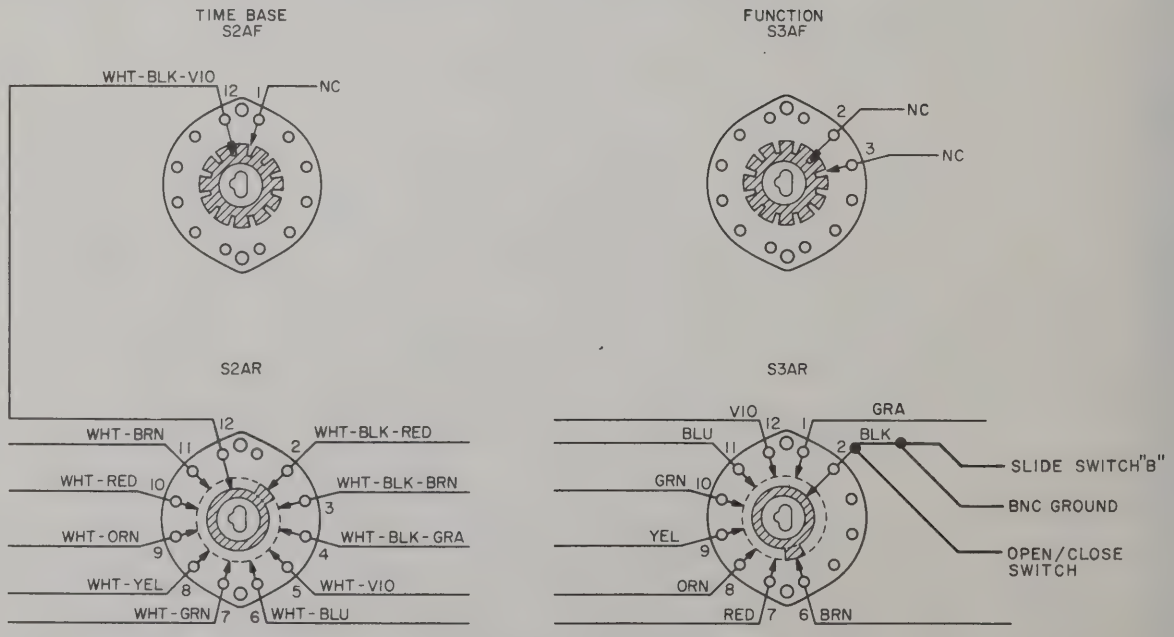
R29,32 NOT ASSIGNED.

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,2,3,5,12, 14,15,16	1901-0040
CR4,6,9,10	1901-0044
CR7	1902-0064
CR8,11	1902-3203
CR13	1910-0034
Q1,2	1855-0306
Q3,5	1854-0009
Q4	1853-0015
U1	1820-0307
U2	1820-0274
U3,4	1820-0441
U5,25	1820-0054
U6,20	1820-0511
U7	1820-0281

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
U8,13	1820-0253
U9	1820-0094
U10,24	1820-0174
U11	1820-0084
U12	1820-0590
U14	1820-0577
U15	1820-0205
U16	1820-0380
U17	1820-0351
U18,19	1820-0581
U21,22	1820-0077
U23	1820-0072
U26	1820-1052
U27	1820-0694

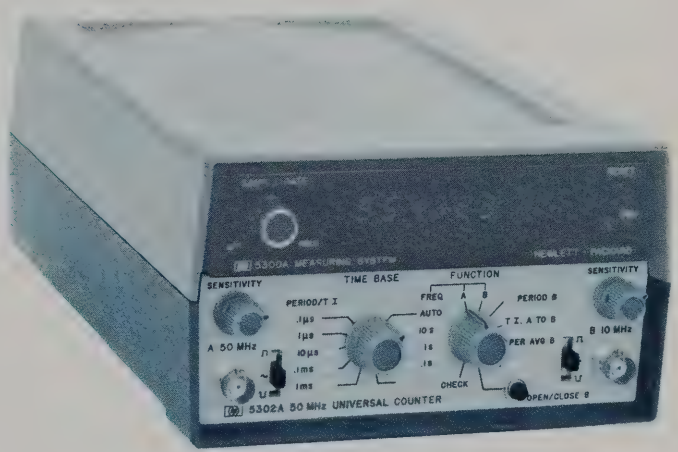


1. TIME BASE SWITCH (S2) SHOWN IN AUTO POSITION. DIRECTION OF TRAVEL IS CW.
2. FUNCTION SWITCH SHOWN IN FREQ. "A" POSITION. DIRECTION OF TRAVEL IS CW.

OPERATING AND SERVICE MANUAL

UNIVERSAL COUNTER

5302A



HEWLETT hp PACKARD

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

SECTION IX B
UNIVERSAL COUNTER
5302A

SERIAL PREFIX 1444A

This Section applies directly to HP Model 5302A, Universal Counters having serial prefix number 1444A, and must be inserted into the 5300A Measuring System Manual.

NEWER INSTRUMENTS

This Section with enclosed "Manual Changes Sheets" applies directly to HP Model 5302A Universal Counters having prefix numbers above 1444A.

OLDER INSTRUMENTS

Changes required to back-date this Section for older instruments are in Section IX B, Subsection VII.

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MICROFICHE PART NO. 05302-90010

PRINTED IN U.S.A.

HEWLETT hp PACKARD

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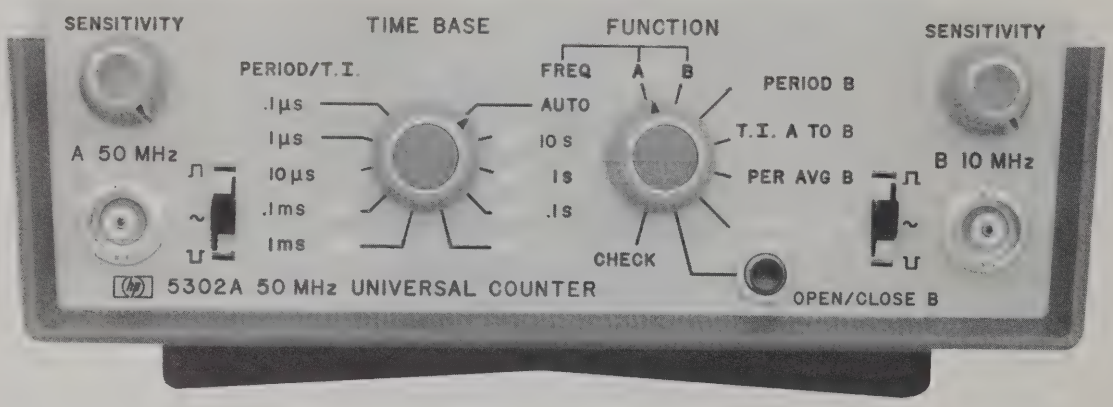
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Figure 9B-1-1. Model 5302A Universal Counter



SECTION IX B
5302A UNIVERSAL COUNTER
SUBSECTION I
GENERAL INFORMATION

9B-1-1. INTRODUCTION

9B-1-2. Description

9B-1-3. The Hewlett-Packard Model 5302A Universal Counter, when plugged onto an HP Model 5300A Measuring System, is capable of: Measuring frequencies up to 50 MHz, Time Interval measurements from 500 nsecs to 1000 seconds, Period and Period Average over a range of 10 Hz to 1 MHz, Ratio of two Frequencies and Totalizing. The electrical and mechanical specifications are listed in Table 9B-1-1.

9B-1-4. Purpose and Use of Section IX B

9B-1-5. Section IX B contains the documentation necessary to operate, maintain, and repair the HP Model 5302A Universal Counter plug-on. Also included are parts lists, component locators, and schematics. This information is intended to be inserted into the 5300A Measuring System manual as part of Section IX of that manual.

9B-1-6. INSTRUMENT IDENTIFICATION

9B-1-7. Hewlett-Packard uses a two-section, nine-digit serial number (0000A00000) mounted on the rear panel to identify the instrument. The first four digits are the serial prefix and the last five digits refer to the specific instrument. If the serial prefix on your instrument differs from that listed on the title page of this section, there are differences between the manual and your instrument. Lower serial prefixes are documented in Section IX B, Subsection VII and higher serial prefixes are covered by a manual change sheet included with the manual.

9B-1-8. Manual Changes and Options

9B-1-9. The title page lists the serial prefix number to which this information directly applies. If the serial prefix is different from the one listed, a change sheet is included describing the required changes. If this change sheet is missing, the information can be supplied by any Hewlett-Packard Sales and Service office listed in Section VI of the 5300A Measuring System manual. Options are listed in Section IX B, Subsection VII.

Table 9B-1-1. 5302A Universal Counter Specifications

INPUT CHANNELS A AND B

RANGE: Channel A: 10 Hz to 50 MHz.
Channel B: 10 Hz to 10 MHz.

SENSITIVITY (min): 25 mV rms sine wave 50 Hz to to 1 MHz.
50 mV rms sine wave 10 Hz to 10 MHz.
100 mV rms sine wave at 50 MHz.
150 mV p-p pulse at 50 nsec minimum pulse width.
Sensitivity can be varied up to 2.5 V rms by adjusting the SENSITIVITY control.

IMPEDANCE: 1 MΩ shunted by less than 30 pF.

OVERLOAD PROTECTION: 500 V (dc + peak ac)
250 V rms, dc to 400 Hz.
10 V rms above 10 MHz.

TRIGGER LEVEL: Selectable positive, negative, or zero V for optimum triggering from sinusoidal inputs or pulses.

SLOPE: Automatically switched to trigger on leading edge of pulse. Positive slope for sinusoidal inputs.

GATE OUT: Rear panel BNC. TTL low level while gate is open.

FREQUENCY

RANGE: Channel A: 10 Hz to 50 MHz. Prescaled by 10.
Channel B: 10 Hz to 10 MHz.

GATES TIMES: Manually selected 0.1, 1 or 10 seconds. AUTO position automatically selects gate time to fill display for maximum resolution within 1-second measurement time.

ACCURACY: ±1 count ± time base accuracy.

DISPLAY: Hz, kHz, and MHz with positioned decimal point.

TIME INTERVAL

RANGE: 500 nsec to 1000 seconds.

INPUT: Channels A and B.

RESOLUTION: 100 nsec to 1 msec in decade steps.

ACCURACY: ±1 count ± time base accuracy ± trigger error.*

DISPLAY: μs, ms, or S (seconds) with positioned decimal point.

PERIOD

RANGE: 10 Hz to 1 MHz.

INPUT: Channel B.

RESOLUTION: 100 nsec to 1 msec in decade steps.

ACCURACY: ±1 count ± time base accuracy ± trigger error.**

DISPLAY: μs, ms, or S (seconds) with positioned decimal point.

PERIOD AVERAGE

RANGE: 10 Hz to 1 MHz.

INPUT: Channel B.

PERIODS AVERAGE: 1 to 10^3 automatically selected for maximum resolution.

RATIO

DISPLAY: F_B/F_A times multiplier (N).

N = 10 to 10^7, selectable in decade steps.

RANGE: Channel A: 10 Hz to 1.0 MHz.
Channel B: 10 Hz to 10 MHz.

ACCURACY: ±1 count of F_B ± trigger error of F_A.*

OPEN/CLOSE (Totalizing)

RANGE: 10 MHz maximum.

INPUT: Channel B.

FUNCTION: Input signal totalized while gate is open. Opening and closing of gate initiated by front panel pushbutton switch.

GENERAL

CHECK: Counts internal 10 MHz reference frequency.

OPERATING TEMPERATURE: 0° to 50°C.

POWER REQUIREMENTS: Including 5300A mainframe, nominally 10 watts.

WEIGHT: Net, 2 lbs. (0.9 kg). Shipping, 3 to 14 lbs. (1.5 kg).

*For any waveshape, trigger error is less than

$$\pm \frac{0.0025}{\text{Signal Slope (V/}\mu\text{s)}\ \mu\text{s}}$$

**Trigger error is less than ±0.3% of one period periods average for signals with 40 dB or better signal-to-noise ratio and minimum amplitude. Decreases with increased signal amplitude and slope.

SECTION IX B
5302A UNIVERSAL COUNTER
SUBSECTION II
INSTALLATION

9B-2-1. UNPACKING AND INSPECTION

9B-2-2. If the shipping carton is damaged ask that the carrier's agent be present when the instrument is unpacked. Inspect the instruments for damage such as scratches, dents, broken knobs, etc. If the instrument is damaged or fails to meet performance tests when used with the 5300A Measuring System notify the carrier and the nearest Hewlett-Packard Sales and Service office immediately. Performance check procedures are located in Section IX, B-5, and Sales and Service offices are listed in Section VI of the 5300A portion of the manual. Retain the shipping carton and the padding material for the carrier's inspection. The Sales and Service office will arrange for the repair or replacement of the instrument without waiting for the claim against the carrier to be settled.

9B-2-3. STORAGE AND SHIPMENT

9B-2-4. PACKAGING. To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your Hewlett-Packard Sales and Service office can provide packaging material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here is one recommended packaging method:

a. The original container is a corrugated cardboard box with 200 lbs. burst test (HP No. 9211-1620). The instrument is secured and protected, while in the box by a top and bottom molded frame of polystyrene foam (HP No. 9220-1545). Also included with the instrument is a plastic dust-protection cover HP Part No. 05300-80004.

9B-2-5. INSTALLATION AND REMOVAL OF PLUG-ON

9B-2-6. The 5302A Universal Counter must be used with a mating 5300A Measuring System before any measurements can be made. To mate the 5302A Universal Counter with the 5300A Measuring System, see Figure 2-1 and Paragraph 2-11 of the 5300A portion of the manual.

9B-2-7. ENVIRONMENT. Conditions during storage and shipment should be normally limited as follows:

a. Maximum altitude: 25,000 feet.

b. Minimum temperature: -40°F (-40°C).

c. Maximum temperature: +167°F (+75°C).

9B-2-8. PORTABLE OPERATION

9B-2-9. The use of the HP Model 5310A Battery Pack enables the 5300A Measuring System and 5302A Universal Counter to be used in areas removed from ac power sources. The 5310A Battery Pack typically provides five hours of portable operating time before recharging. Tables 1-2 and 1-4 of 5300A portion of the manual lists the HP 5310A Battery Pack as an available accessory. Documentation on the 5310A is also included in Sections IV through VIII of the 5300A portion of the manual. To prepare the 5300A/5302A for portable operation, refer to Paragraph 2-15 and Figure 2-2 steps a to c of 5300A portion of manual.

SECTION IX B
5302A UNIVERSAL COUNTER
SUBSECTION III
OPERATION

9B-3-1. OPERATING INFORMATION

9B-3-2. The 5302A Universal Counter Plug-on may be used to measure frequencies up to 50 MHz, Period and Period Average to 1 MHz, Time Interval from 500 nsec to 1000 seconds or Ratio measurements from 10 Hz to 10 MHz. The instrument may also be used to Totalize input signals.

9B-3-3. The instrument front panel contains several controls and connectors used to make measurements with Channel A or Channel B or are used to control both channels. Some of these controls are used in signal conditioning to enable the user to take advantage of the instrument's built-in precision.

9B-3-4. There are three basic signal conditioning controls used in both Channel A and/or Channel B. There are:

a. Sensitivity controls for Channel A and B.

b. Waveform controls for Channel A and B.

c. TIME BASE control for Channel A and B.

9B-3-5. SENSITIVITY CONTROLS (Both Channels). A typical signal may contain large harmonics or noise, which can introduce inaccuracies in the reading. These sources of error may be minimized by correct use of the various signal conditioning controls.

9B-3-6. The input amplifiers and trigger circuits of both channels include a "dead band" or hysteresis. In order to trigger the counter, the input signal must pass completely through this "dead band". Any noise or unwanted signal, cannot cause a false trigger unless the amplitude of the noise is greater than the "dead band". The SENSITIVITY control adjusts the width of the dead band so that it is small enough to trigger on the signal but large enough to reject noise and harmonics (as shown in Figure 9B-3-1).

9B-3-7. To set the SENSITIVITY control for the best reading, set the control full ccw and increase the SENSITIVITY (cw) until stable triggering occurs. Increase the SENSITIVITY a fraction more to allow for amplitude variations in the signals. If the signal contains large amplitude modulation, the sensitivity must be adjusted to trigger on all cycles of the carrier frequency. In this case, it may be preferable to begin with the highest sensitivity setting (full cw) then decrease the sensitivity (ccw) to reject any noise until the display is stable. The sensitivity setting is more easily adjusted with a fast gate time such as .1-second. Gate time may be increased for finer resolution.

9B-3-8. WAVEFORM CONTROLS (Both Channels). This switch is normally used in the " ∿ " position and for most signals including sine wave, square wave, sawtooth wave, and pulses which have an approximate 50% duty-cycle. The hysteresis dead band in this position is centered on the average value of the signal. Since the amplifier is ac coupled, a dc offset in the signal does not effect triggering.

9B-3-9. The two pulse positions on the waveforms switch should be used only with positive or negative pulses where the pulse width is short compared to the spacing between pulses. In this case, the average value of the signal is close to the baseline of the pulse which is not the optimum point to trigger the counter. In the positive pulse position, the dead band is offset to respond only to the positive segment of the pulse above the average value. In the negative pulse position, the dead band is offset to respond to the negative part of the signal. In either case, the effect of the SENSITIVITY control is to move the center of the dead band, as well as its width, so that the trigger circuits still respond only to the positive part or the negative part of the signal as shown in Figure 9B-3-1.

9B-3-10. TIME BASE CONTROL. The TIME BASE control switch provides four gate time positions (black) and seven multiplier settings (N white) for Ratio mode. It also provides decade-step resolution settings from .1 μsec to 1 ms (blue) for Period or Time Interval measurements. These various positions are selectable for Channel A and/or B through the FUNCTION switch. These are:

a. AUTO. This is the most useful setting for measuring an unknown frequency. It will automatically select a gate time of:

1-second for frequencies up to 900 kHz when using Channel B and up to 9 MHz when using Channel A.

0.1-second for frequencies between 900 kHz and 9 MHz when using Channel B and 9 MHz to 50 MHz when using Channel A.

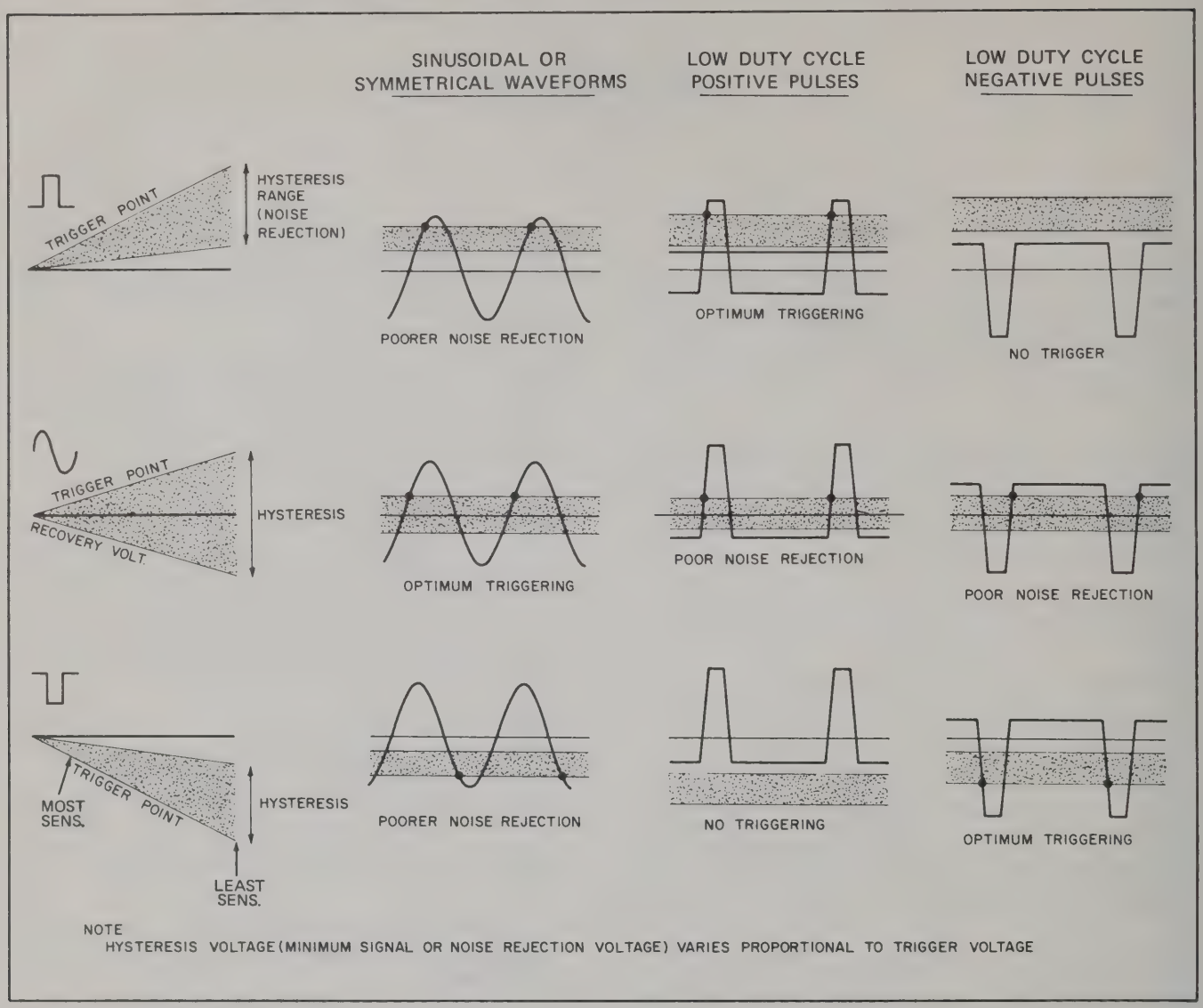
The display will never overflow in the AUTO position. The recycle time is held constant at 1-second plus the sample rate time for all frequencies.

b. 0.1 SEC. This position provides the fastest recycle time with a constant 10 Hz resolution when using Channel B and 100 Hz resolution when using Channel A. It is most useful for monitoring fast changes in the input frequency and for setting the signal conditioning controls.

c. 1 SEC. Provides constant 1 Hz resolution when using Channel B and 10 Hz resolution when using Channel A. Since the recycle time is the same as in AUTO this position offers an advantage only for measuring signals above 900 kHz with a 1 Hz resolution. Display will overflow above 1 MHz.

d. 10 SEC. Provides 0.1 Hz resolution in Channel B and 1 Hz resolution in Channel A. This setting is not available in AUTO and must be selected manually if the extra precision is required.

Figure 9B-3-1. Signal Conditioning by Waveform Switch and Sensitivity Control



e. N (white). Provides decade-step multiplier settings when FUNCTION switch is set to RATIO.

f. PERIOD/T.I. (blue). Decade step resolution settings may be selected when using Period B or T.I. A to B modes.

9B-3-11. MODES OF OPERATION

9B-3-12. The 5302A offers seven modes of operation and a Self-Check position. Some of the modes are available on both channels while other modes are available only on one channel (either A or B). In all cases, the modes are selected by the FUNCTION switch. The modes are:

a. Frequency (Channel A or B).

b. Period (Channel B only).

c. Time Interval (Channel A to B).

d. Period Average (Channel B only).

e. Ratio, $\frac{B}{A}$ X N (Channel A and B)

f. Totalize, OPEN/CLOSE B (Channel B only).

g. Check Mode.

9B-3-13. Frequency Mode, Channel A

9B-3-14. Frequency measurements using Channel A enables the user to make frequency measurements from 10 Hz to 50 MHz. When using Channel A the input signal is prescaled by 10.

9B-3-15. Frequency Mode, Channel B

9B-3-16. Frequency measurements using Channel B enables the user to make frequency measurements from 10 Hz to 10 MHz. Since no prescaling occurs, higher resolution measurements can be made using Channel B.

9B-3-17. Period Mode, Channel B

9B-3-18. The period mode allows single period measurements to be made with frequencies of 10 Hz to 1 MHz into Channel B. In Period B measurements the Time Base gate time is selectable from .5 μsec to 1 msec. The accuracy is ± 1 count ± time base accuracy ± trigger error.

9B-3-19. Time Interval Mode, Channel A to B

9B-3-20. The time interval mode allows time measurements, between points on one or two waveforms, to be made. The range of measurements is .1 μsec to 1000 seconds with .1 μsec to 1 msec resolution in decade steps. Channel A input signal opens the main gate and Channel B closes it. An output is available at the rear of the unit during the time the main gate is open. Accuracy is ± 1 count ± time base accuracy ± trigger error. The trigger error for any waveshape is less than

$$\pm \frac{0.005}{\text{Signal Slope (V/}\mu\text{s)}\ \mu\text{s}}$$

9B-3-21. Period Average Mode, Channel B

9B-3-22. The period average mode allows multiple period averages to be made with frequencies of 10 Hz to 1 MHz into Channel B. Periods averaged is automatically selected from 1 to 10^3 for maximum resolution. For frequencies less than 110 Hz, one period is measured; for frequencies from 110 Hz to 1100 Hz, ten periods are averaged; for frequencies from 1100 Hz to 11 kHz, 100 periods are averaged; for frequencies above 11 kHz, 1000 periods are averaged.

9B-3-23. Ratio Mode, Channel B/A

9B-3-24. The ratio of the Channel B input signals (from 10 Hz to 10 MHz) to the Channel A input signals (from 10 Hz to 1 MHz) times multiplier N, can be measured. Multiplier is selectable from 10 to 10^7. Accuracy is ± 1 count of Frequency B, ± trigger error of Frequency A.

9B-3-25. Totalizing Mode, Channel B

9B-3-26. Input Signals up to 10 MHz, applied to Channel B can be totalized. Totalizing is initiated by pressing the OPEN/CLOSE B switch and terminated by pressing the OPEN/CLOSE B switch a second time.

9B-3-27. CHECK Mode

9B-3-28. The Check mode provides a position where the instrument 10 MHz oscillator and counting logic is verified. The 5300A displays 10.0000 MHz ± 1 count when circuits are functioning properly.

9B-3-29. CONTROLS AND CONNECTORS

9B-3-30. Figures 9B-3-2 and 9B-3-3 list the various front panel controls and connectors and the rear panel connector.

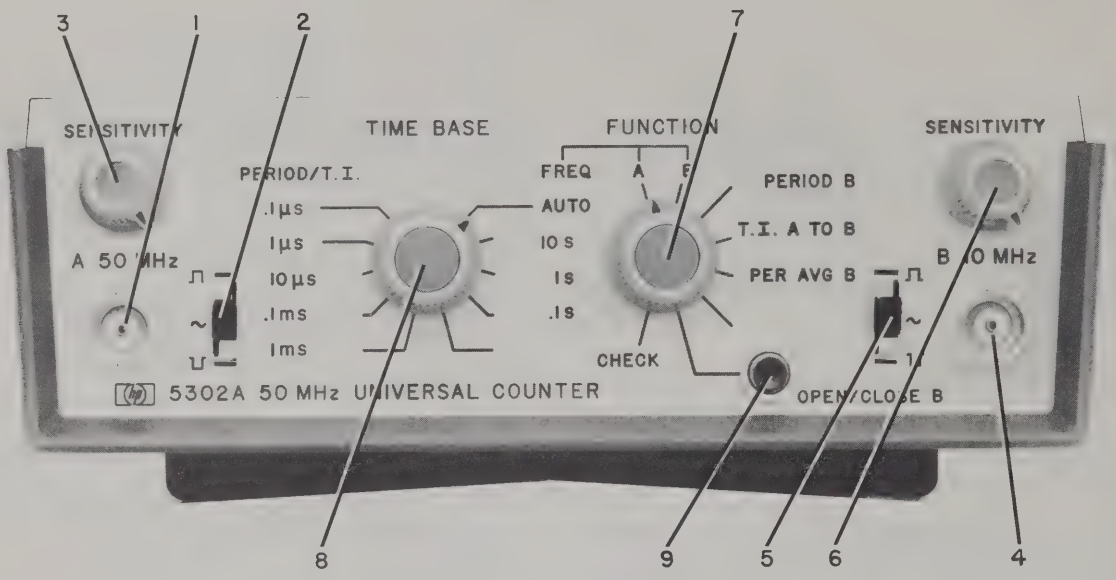
9B-3-31. OPERATING PROCEDURES

9B-3-32. The operating procedures for making measurements in the various modes are listed in Figures 9B-3-4 through 9B-3-10.

WARNING

TO AVOID POSSIBILITY OF BODILY INJURY AND/OR EQUIPMENT DAMAGE WHILE PERFORMING THE FOLLOWING PROCEDURE, BE SURE TO OBSERVE POLARITY REQUIREMENTS WHEN CONNECTING TEST LEADS. (HEWLETT-PACKARD RECOMMENDS USING AN ISOLATION TRANSFORMER WHEN MEASURING AC LINE FREQUENCIES.) ADDITIONALLY, DO NOT EXCEED THE INPUT VOLTAGE LIMITATIONS AS SPECIFIED IN TABLE 9B-1-1.

Figure 9B-3-2. Front Panel Controls and Connectors



CHANNEL A
Grouped on left side of panel

1. "A 50 MHz" connector. Input signals from 10 Hz to 50 MHz can be measured using this connector. Input signal is prescaled by 10.

2. Waveform Switch. Set to correspond to one of three types of input signals. (See Paragraph 9B-3-8 for correct adjustment.)

 a. ⎍ : Input signals to be measured is positive-going pulse of low duty-cycle.

 b. ∿ : Input signal to be measured is sinusoidal or is another type of signal with about a 50% duty-cycle.

 c. ⎎ : Input signal to be measured is negative-going pulse of low duty-cycle.

3. SENSITIVITY. Potentiometer adjusts counter channel A sensitivity; maximum sensitivity is at full cw.

CHANNEL B
Grouped on right side of panel

4. "B 10 MHz" connector. Input signals from 10 Hz to 10 MHz can be measured using this connector.

5. Waveform switch. Set to correspond to one of three types of input signals. (See Paragraph 9B-3-8 for correct adjustment.)

 a. ⎍ : Input signals to be measured is positive-going pulse of low duty-cycle.

 b. ∿ : Input signal to be measured is sinusoidal or is another type of signal with about a 50% duty-cycle.

 c. ⎎ : Input signal to be measured is negative-going pulse of low duty-cycle.

6. SENSITIVITY. Potentiometer adjusts counter Channel B sensitivity; maximum sensitivity is at full cw.

Figure 9B-3-2. Front Panel Controls and Connectors (Continued)

7. FUNCTION. Eight position switch used to select the desired mode of operation. The positions are:

 a. FREQ A. Enables frequency measurements of 10 Hz to 50 MHz to be made using Channel A connector and signal conditioning controls.

 b. FREQ B. Enables frequency measurements of 10 Hz to 10 MHz to be made using Channel B connector and signal conditioning controls.

 c. PERIOD B. Enables single period measurements to be made from Channel B with frequencies of 10 Hz to 1 MHz.

 d. T.I. A to B. Enables time interval measurements to be made between signals into Channel A and signals into Channel B. Channel A starts measurements, Channel B stops it.

 e. PER AVG B. Enables multiple period averages to be made from Channel B with frequencies of 10 Hz to 1 MHz. Periods averaged is a automatically selected from 1 to 10^3.

 f. RATIO $\frac{B}{A}$ X N. Enables the ratio of Channel B signals to Channel A signals to be taken. Channel A input is 10 Hz to 1 MHz and Channel B input is 10 Hz to 10 MHz. Multiplier (N) is selectable from 10 to 10^7.

 g. OPEN/CLOSE B. Enables input signals to Channel B (10 Hz to 10 MHz) to be totalized. Totalizing is initiated by pressing the OPEN/CLOSE B switch and terminated by pressing this switch a second time. Restarted by pressing the switch a third time.

 h. CHECK. Self-Check position verifies that the 5300A 10 MHz crystal oscillator and the counting logic is functioning correctly.

8. TIME BASE. This 10-position switch performs three functions:

 a. Gate time controls for frequency measurements.

 b. Period/Time Interval resolution control.

 c. Ratio Multiplier control for ratio measurements.

 FREQ. (black) Gate time positions are:

 a. AUTO. Automatically selects the measurement gate time needed to fill the display for maximum resolution for the signal being measured with a maximum time of 1 second.

 b. 10S, 1S, .1S. Counter gate time is 10 seconds, 1-second, or .1-second corresponding to the switch position.

 PERIOD/T.I. (blue) positions are:

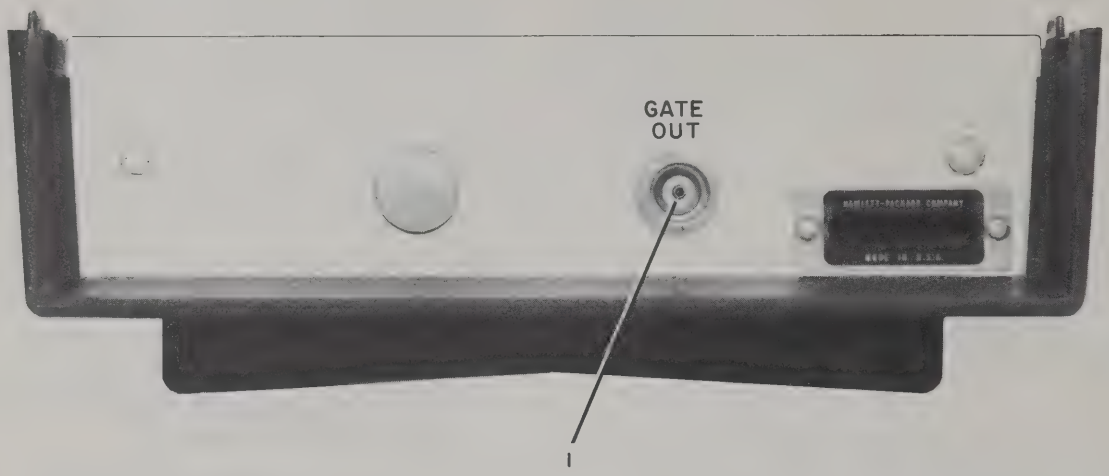
 .1 μs, 1 μs, 1 ms, 1 ms. In Period measurements and Time Interval measurements, the resolution of the measurement is adjustable from .1 μsec to 1 msec in decade steps.

 "N" Multiplier (white) positions are:

 10, 10^2, 10^3, 10^4, 10^5, 10^6, 10^7. In Ratio mode the multiplier is selectable, in decade steps, from 10 to 10^7.

9. OPEN/CLOSE B Pushbutton switch, effective in indicated position of FUNCTION switch. Totalizing of Channel B input signals started by pressing this switch and terminated by pressing it a second time. Restarted by pressing the switch a third time.

Figure 9B-3-3. Rear Panel Connector

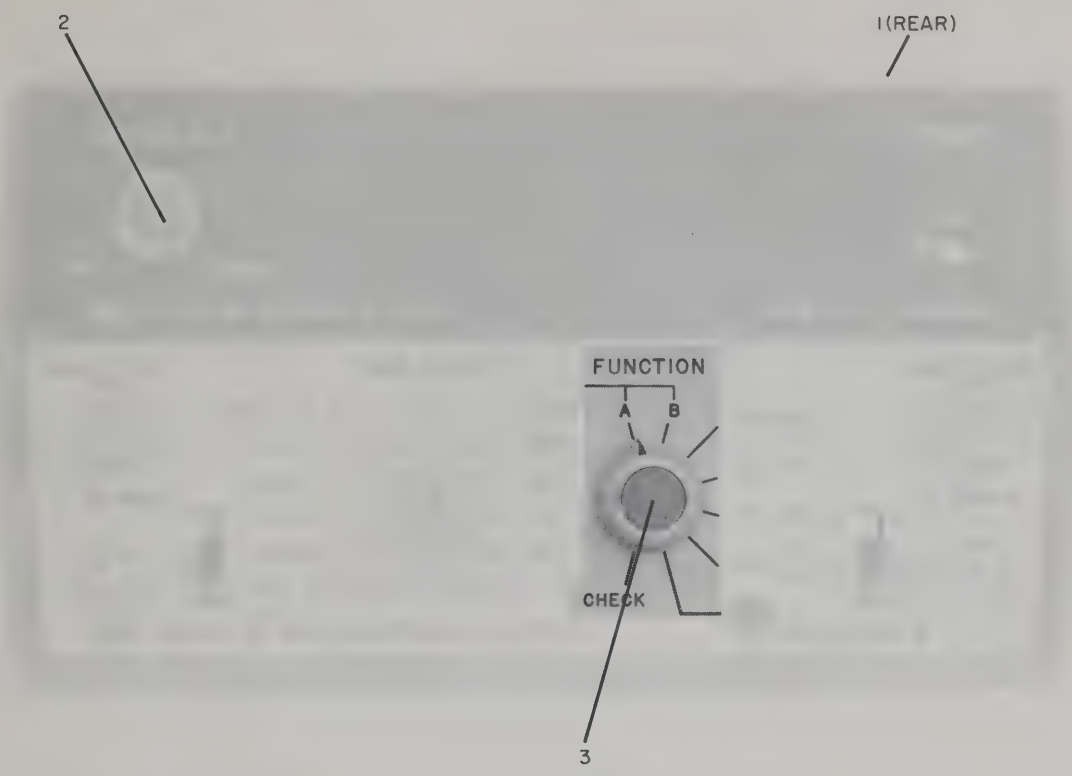


1. GATE OUT: A TTL-LOW level is available while the instrument gate is open.

Caution

DO NOT CONNECT EXTERNAL VOLTAGES TO GATE-OUT CONNECTOR.

Figure 9B-3-4. Making Self-Check Measurements

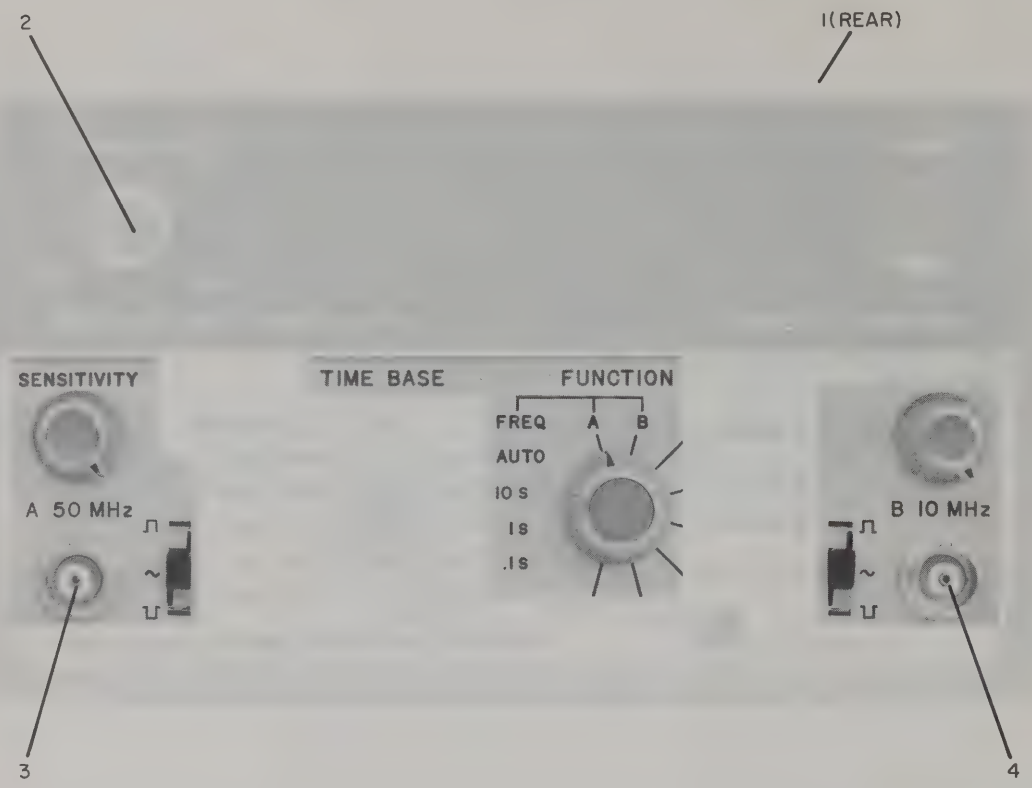


1. Connect ac power to 5300A ac receptacle.

2. Turn ac power "on" with 5300A SAMPLE RATE control. Adjust SAMPLE RATE for desired display time.

3. Set 5302A FUNCTION SWITCH TO CHECK; TIME BASE switch may be set to any position. Display should be 10.0000 MHz ± 1 count.

Figure 9B-3-5. Making Frequency Measurements Using Channel A or B



1. Connect ac power to 5300A ac LINE receptacle.

2. Turn ac power "on" with 5300A SAMPLE RATE control and adjust sample rate for desired display time.

3. For frequencies 10 Hz to 50 MHz use Channel A as follows:

 a. Set FUNCTION to "A".

 b. Set "A" Waveform switch to " ∿ " and TIME BASE to an appropriate gate time (see paragraph 9B-3-8 for Waveform controls operating information). For low duty cycle pulse measurements where pulse widths are short compared to pulse spacing, set Waveform "A" switch to " ⎍ " or to " ⎍ " depending on input pulse polarity.

 c. Set "A" SENSITIVITY to full ccw (see SENSITIVITY CONTROLS operating information, paragraph 9B-3-5).

 d. Connect input signal to be measured to "A 50 MHz" connector.

 e. Slowly adjust SENSITIVITY cw for a stable display.

 f. Set TIME BASE to desired gate time.

 g. Instrument display is the input signal frequency.

4. For frequencies 10 Hz to 10 MHz use Channel B as follows:

 a. Set FUNCTION to "B".

 b. Set "B" Waveform switch to " ∿ " and TIME BASE to an appropriate gate time (see paragraph 9B-3-8 for Waveform Controls operating information). For low duty cycle pulse measurements where pulse widths are short compared to pulse spacing, set Waveform "B" switch to " ⎍ " or to " ⎍ " depending on input pulse polarity.

 c. Set "B" SENSITIVITY to full ccw (see SENSITIVITY CONTROLS operating information, paragraph 9B-3-5).

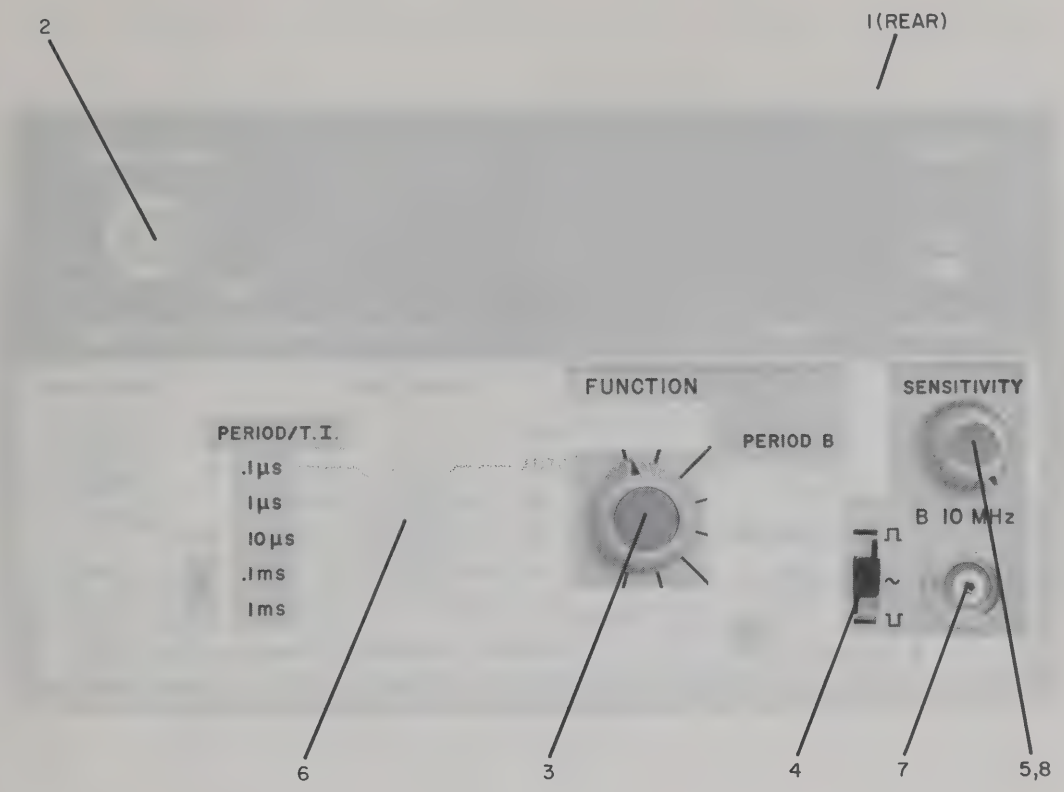
 d. Connect input signal to be measured to "B 10 MHz" connector.

 e. Slowing adjust "B SENSITIVITY control cw for a stable display.

 f. Set TIME BASE to desired gate time.

 g. Instrument display is the input signal frequency.

Figure 9B-3-6. Making Period Measurements



1. Connect ac power to 5300A ac LINE receptacle.

2. Turn ac power "on" with 5300A SAMPLE RATE control. Adjust SAMPLE RATE for desired display time.

3. Set 5302A FUNCTION switch to PERIOD B.

4. Set "B" Waveform switch to correspond to type of signal being measured (see Paragraph 9B-3-8 for Waveform Controls operating information).

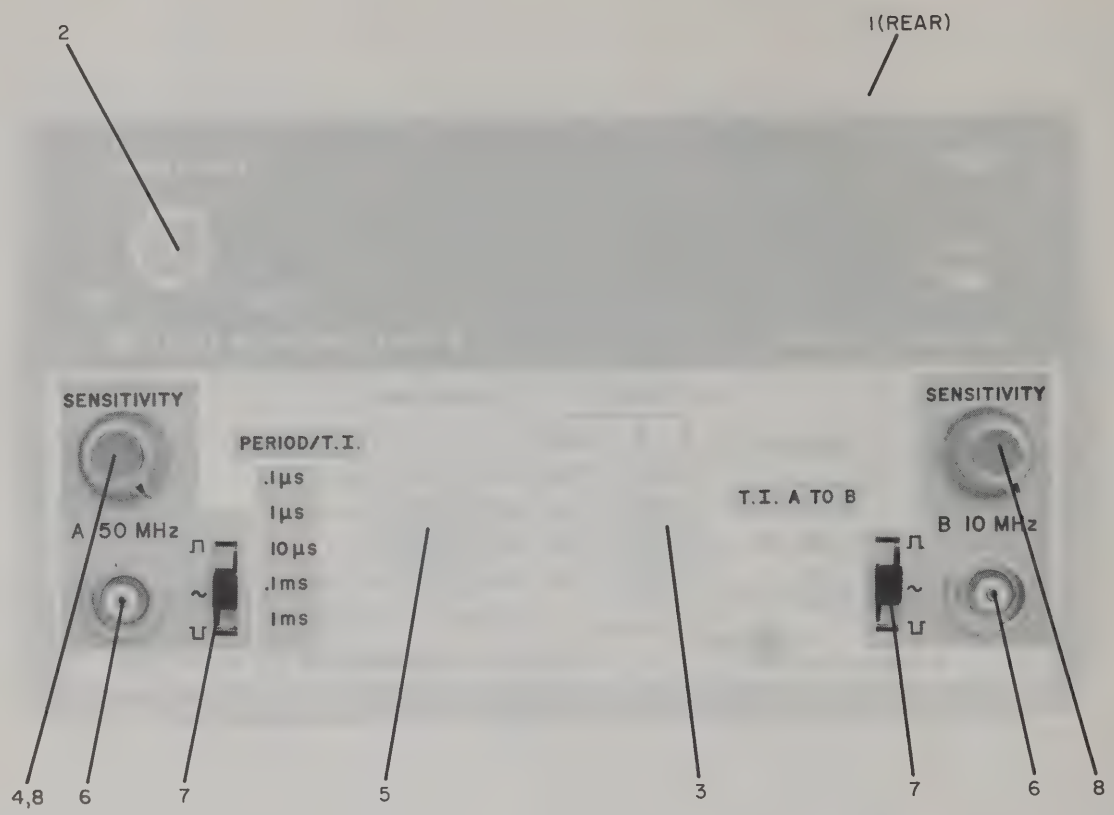
5. Adjust "B" SENSITIVITY to full ccw (see Paragraph 9B-3-5 for SENSITIVITY CONTROLS operating information).

6. Set TIME BASE to desired PERIOD resolution (.1 μs to 1 ms).

7. Connect input signal (10 Hz to 1 MHz) to "B 10 MHz" connector.

8. Adjust "B" SENSITIVITY control slowly cw for a stable display.

Figure 9B-3-7. Making Time Interval Measurements



1. Connect ac power to 5300A ac LINE receptacle.

2. Turn ac power "on" with 5300A SAMPLE RATE control and adjust sample rate for desired display time.

3. Set 5302A FUNCTION switch to T.I. A to B.

4. Adjust "A" SENSITIVITY control to full ccw and "B" SENSITIVITY controls to full cw (see paragraph 9B-3-5 for SENSITIVITY CONTROLS operating information).

5. Set TIME BASE to desired T.I. resolution to be counted (.1 μs to 1 ms).

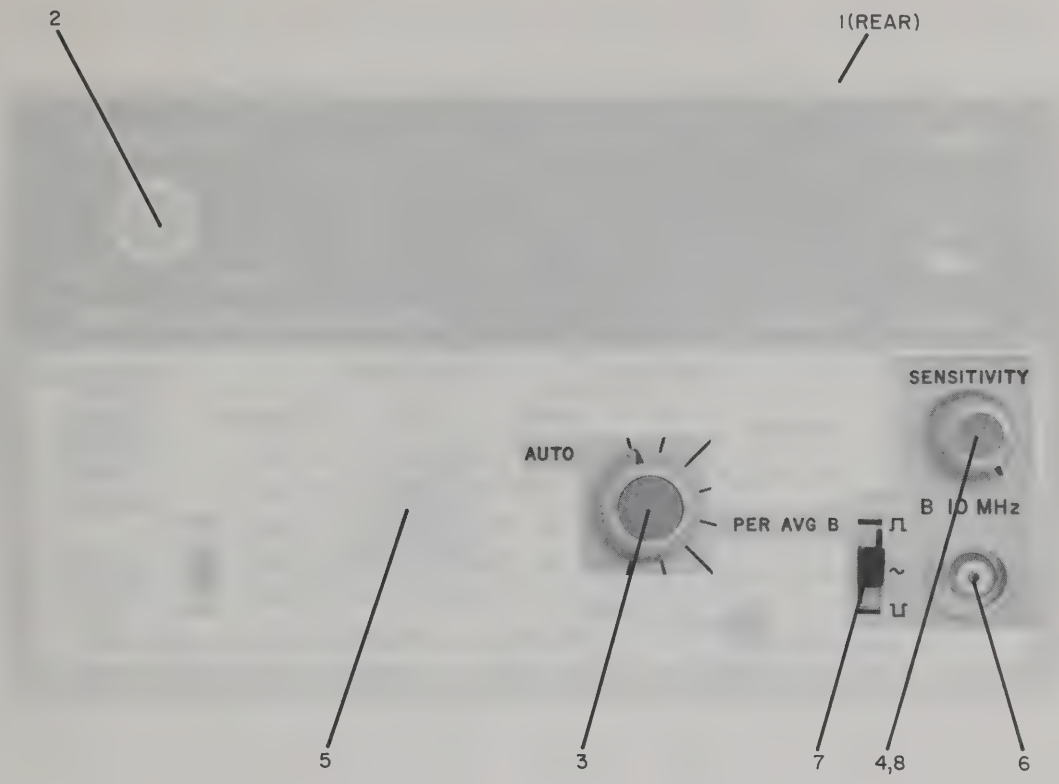
6. If the Start and Stop signals are from separate sources connect the Start signal to "A 50 MHz" connector and the Stop signal to "B 10 MHz" connector. If the Start and Stop signals are from a common source, use a BNC "Tee" connector to interconnect the signal source, "A 50 MHz" channel and "B 10 MHz" channel.

7. Set the "A" Waveform switch to correspond to the type of signal connected to A 50 MHz connector. Set the "B" Waveform switch to correspond to the type of signal connected to B 10 MHz connector.

8. Slowly adjust the "A" SENSITIVITY cw until a display is observed, then adjust "B" SENSITIVITY slowly ccw until the display is stable.

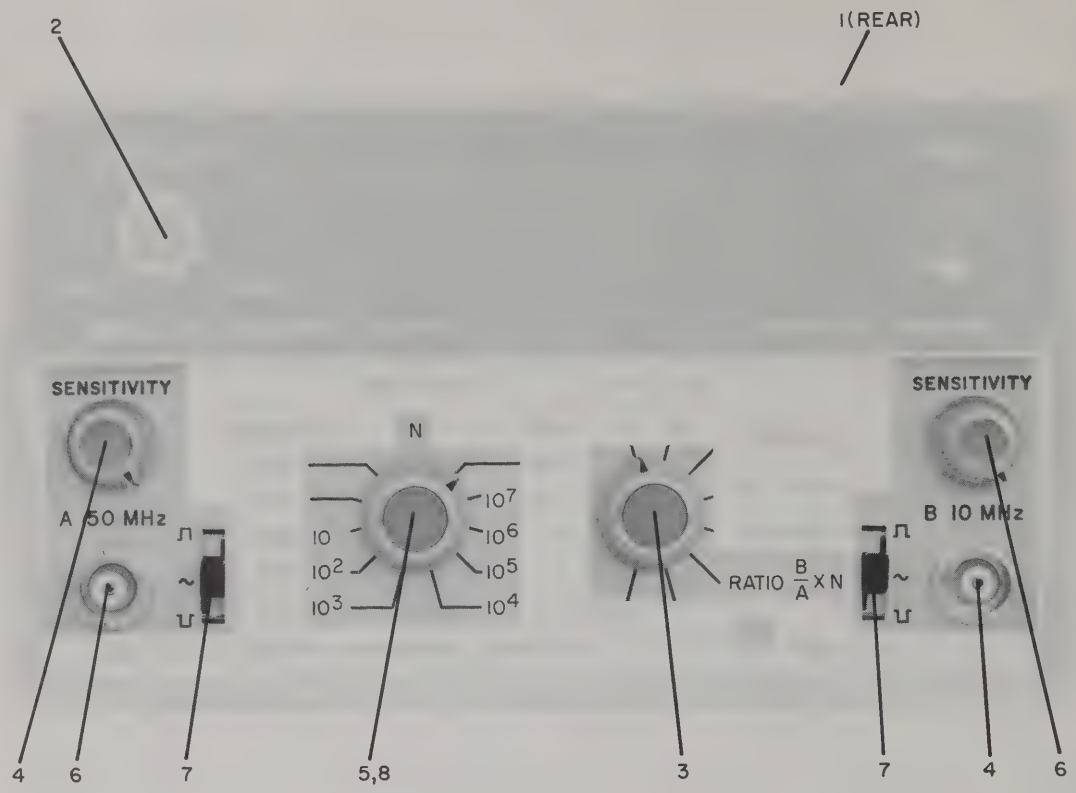
9. The Time interval is displayed in μsec, msec, or seconds depending on T.I. setting selected.

Figure 9B-3-8. Making Period Average Measurements



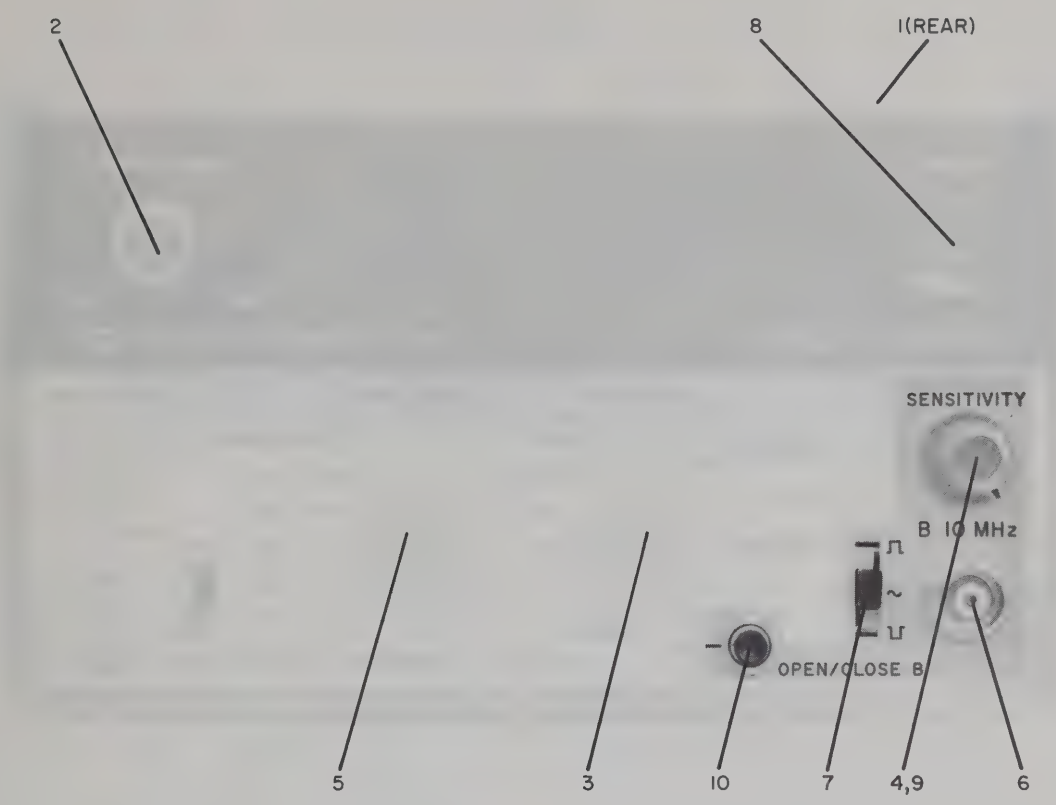
1. Connect ac power to 5300A ac LINE receptacle.
2. Turn ac power "on" with 5300A SAMPLE RATE control. Adjust SAMPLE RATE for desired display time.
3. Set 5302A FUNCTION to PER AVG B.
4. Adjust "B" SENSITIVITY to full ccw (see Paragraph 9B-3-5 for SENSITIVITY CONTROLS operating information).
5. TIME BASE adjustment is not required; instrument gate-time is automatic. Periods averaged are 1 to 10^3.
6. Connect input signal (10 Hz to 1 MHz) to "B 10 MHz" connector.
7. Set "B" Waveform switch to correspond to type of signal being measured (see Paragraph 9B-3-8 for Waveform Controls operating information).
8. Adjust "B" SENSITIVITY control slowly cw for a stable display.

Figure 9B-3-9. Making Ratio Measurements



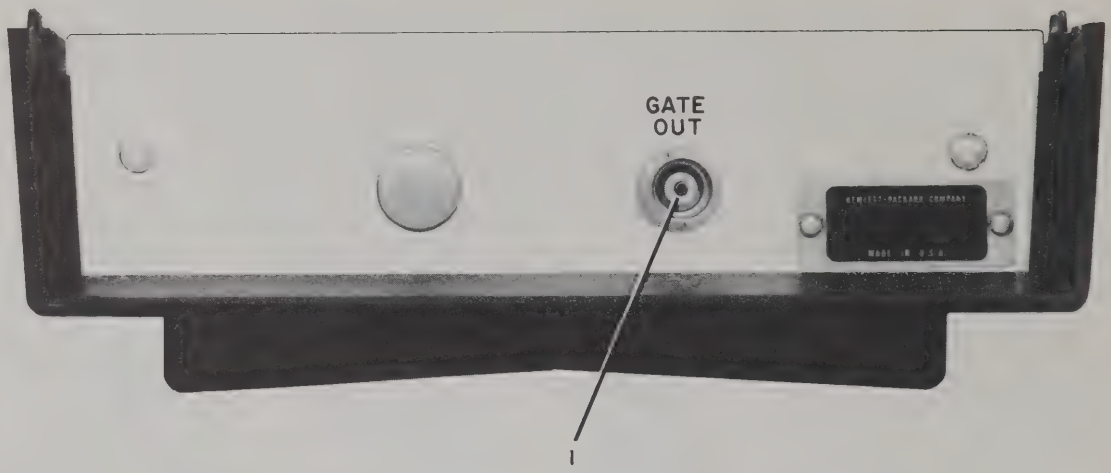
1. Connect ac power to 5300A LINE receptacle.
2. Turn ac power "on" with 5300A SAMPLE RATE control and adjust sample rate for desired display time.
3. Set 5302A FUNCTION switch to RATIO $\frac{B}{A}$ X N.
4. Set "A" and "B" SENSITIVITY controls full cw (see Paragraph 9B-3-5 for SENSITIVITY CONTROLS operating information).
5. Set TIME BASE N (white) to desired setting (10 white to 10^7 white).
6. Connect lower frequency signal to "A 50 MHz" connector (10 Hz to 1 MHz); connect higher frequency signal to "B 10 MHz" connector (10 Hz to 10 MHz).
7. Set "A" and "B" Waveform switches to correspond to type of signals connected to "A" and "B" input connectors.
8. Divide display by N multiplier setting (white numbers) to obtain ratio.

Figure 9B-3-10. Making Totalizing Measurements



1. Connect ac power to 5300A ac LINE receptacle.
2. Turn ac power "on" with 5300A SAMPLE RATE control. Adjust SAMPLE RATE for desired display time.
3. Set 5302A FUNCTION to OPEN/CLOSE B.
4. Adjust "B" SENSITIVITY to full ccw (see paragraph 9B-3-5 for SENSITIVITY CONTROLS operating information).
5. TIME BASE adjustment is not required; instrument gate is controlled by operator when OPEN/CLOSE B pushbutton is pressed.
6. Connect input signal (10 MHz maximum) to "B 10 MHz" connector.
7. Set "B" Waveform switch to correspond to type of signal being totalized (see paragraph 9B-3-8 for Waveform Controls operating information).
8. Press RESET; press OPEN/CLOSE B switch; C lamp should come on.
9. Slowly adjust "B" SENSITIVITY cw until counting occurs on display. Display will accumulate at a rate dependent on input signal frequency.
10. When display has accumulated the desired number of counts, press OPEN/CLOSE B to stop totalizing.
11. If the operator wants to totalize from the number accumulated in the display, press the OPEN/CLOSE B switch. If a new totalizing measurement is made, press RESET before pressing OPEN/CLOSE B switch.

Figure 9B-3-11. Using GATE OUT Connector



The 5302A rear-panel GATE OUT connector provides a TTL low level signal during the time the instrument gate is open. This signal can be used, when making Period, Time Interval and Period Average measurements, to control an oscilloscope so that only the measured portion of the signal is displayed by the oscilloscope.

1. To use this feature in Period (Figure 9B-3-6) or Period Average (Figure 9B-3-8) modes proceed as follows:

 a. Connect the signal to be measured to oscilloscope Channel A or B. Connect the 5302A GATE OUT connector, using a BNC Tee, to the oscilloscope rear-panel Z AXIS input and the oscilloscope front-panel EXT INPUT.

 b. Set HP 180A oscilloscope controls as follows:

 TRIGGER to EXT.

 SLOPE to +.

 Display to A + B.

 Coupling to ACF.

 SWEEP MODE to NORM.

 TIME/CM for one complete cycle of signal.

 c. Set remaining oscilloscope controls for a useable display.

 d. To more easily view the measured portion of the input signal, reduce the oscilloscope INTENSITY.

 e. In PER AVG Mode, the periods averaged are automatically selected. The change-over point may be monitored by varying the input frequency and observing the number of cycles displayed on the oscilloscope.

2. To use this feature in Time Interval Mode (Figure 9B-3-7) proceed as follows:

 a. Connect equipment as shown in Table 9B-5-1, No. 6, Figure C, Time Interval Measurements.

 b. In addition to connections made in step a, connect 5302A GATE OUT connector, using a BNC Tee, to oscilloscope rear-panel Z AXIS input and to oscilloscope front-panel EXT INPUT.

 c. Set HP 180A oscilloscope controls as follows:

 TRIGGER to EXT.

 SLOPE to —.

 Coupling to ACF.

 SWEEP MODE to NORM.

 TIME/CM for one complete Time Interval of signal.

 d. Set remaining oscilloscope controls for a useable display.

 e. To more easily view the measured time interval portion of the input signals, reduce the oscilloscope INTENSITY.

SECTION IX B
5302A UNIVERSAL COUNTER
SUBSECTION IV
THEORY OF OPERATION

9B-4-1. INTRODUCTION

9B-4-2. This subsection describes the theory of operation for the 5302A 50 MHz Universal Counter. Basic operation of gates and certain amplifiers is located in Section IV of the 5300A portion of the manual.

9B-4-3. To simplify measurement making when using channel A and/or channel B, refer to operating information starting with paragraph 9B-3-1 for optimum adjustment of the various controls.

9B-4-4. 5302A CIRCUIT THEORY (Figure 9B-8-1)

9B-4-5. INPUT AMPLIFIERS. The input signals at J1 or J2 are coupled to input buffers Q1, Q2 through C1 or C2. Signals greater than ±7 volts are clipped by the diodes CR4, CR6, CR9, CR10. Gate bias for Q1 and Q2, is provided by breakdown diode CR7 and resistors R9 and R11. Q1 and Q2 provide impedance-conversion from the 1 megohm INPUT to the 1 kΩ SENSITIVITY controls R1 and R2. R1 and R2 adjust the signal amplitude applied to the differential amplifiers U8A and U13A. The signal is limited to 1.4V p-p by CR1, CR3, and CR2, CR5. The differential amplifiers are biased at the proper point by R12, R13, R15, and R16 from the differential amplifiers' internal bias supply.

9B-4-6. In channel A, the U13A differential output is fed to the differential Schmitt-Trigger U13C, which converts the signal to fast risetime square waves compatible with digital logic, and rejects noise which may be present with the desired signal. Buffer stage U13B drives the prescaler and level converter.

9B-4-7. In channel B the U8A amplifier output is fed to the Schmitt-Trigger, U8C. U8B is a unity-gain amplifier whose output supplies the Schmitt-Trigger bias voltage, and buffers it from the input bias source.

9B-4-8. A dc offset voltage in the "pulse positions" of S1 or S2 is applied to the amplifiers and Schmitt-Triggers to make them handle low duty-cycle pulses. In channel A the offset is applied directly to the Schmitt-Trigger through R5 or R6. In channel B the offset is applied to the input amplifier through R3 or R4.

9B-4-9. Channel A signals are available to the logic circuits either direct or prescaled by 10 through U18 and U19. In the Frequency Mode, the signals at the output of buffer U13B go to the ECL decade-divider U18 and U19. The prescaled output from the decade goes to U26A, which converts the ECL logic levels to TTL levels for use in the remainder of the 5302A.

9B-4-10. In Time Interval and Ratio measurements an unprescaled output is desired and the channel A signal is taken from buffer amplifier U13B directly to a level-translator gate U26E. To ensure that the leading edge of the signal triggers the circuitry, the "CHAN A" signal goes to EXCLUSIVE OR gate U27C(9). The other input of this gate is controlled by the channel A waveform switch S1. In the ⎍ and ∿ positions, this input is low, while in the ⎍ position, it is pulled high through R52. Thus, in ⎍ pulse and ∿ the gate (U27C) acts as a non-inverting buffer while in ⎍ it acts as an inverter.

9B-4-11. The output of the channel B Schmitt-Trigger goes directly to the U26(3,4) level-translator gate and then to an EXCLUSIVE OR Inverter/Buffer described in paragraph 9B-4-10.

9B-4-12. FREQUENCY MODE (Figures 9B-5-2 and 3)

9B-4-13. In frequency A or frequency B modes, the signal from one of the input amplifiers CHA "OUT" and CHB "OUT" is applied to F1 A1P1(5) through U16 F1 switch. The F1 frequency is determined by counting F1 for an accurately known period of time. This counting time or gate-time can be .01 sec, .1 sec, 1 sec, or 10 sec, depending upon frequency and resolution desired.

9B-4-14. Accurate measurement periods are derived from a 10 MHz crystal-controlled oscillator through a chain of 8-decade dividers. The outputs of the dividers are multiplexed onto a single line and gated to provide a series of 9 pulses in 10 seconds. The first, or start pulse indicates "time zero" and the beginning of a measurement cycle (see Figure 9B-4-1). The other pulses are generated at precisely 1 µsec, 10 µsec, 100 µsec, 1 ms, 10 ms, 100 ms, 1 sec, and 10 sec after the start pulse. Because the pulses are logarithmically spaced in time, this line is termed "$\overline{\text{LOG}}$" output. Another timing signal, TB OUTPUT, (time base output), is available which gives a level change concurrent with one of the $\overline{\text{LOG}}$ pulses (see Figure 9B-4-2). The specific time from the start pulse to this level change is programmed by a three-line code (TB SELECT A, B, C).

Figure 9B-4-1. LOG Cycle

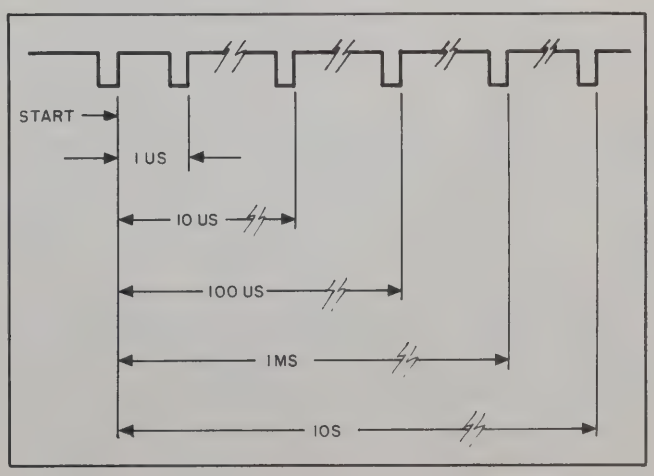
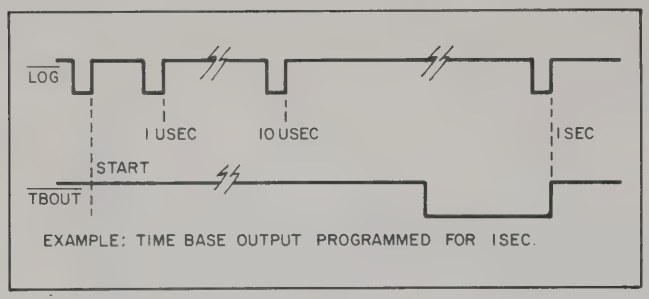


Figure 9B-4-2. TIME BASE/LOG Outputs

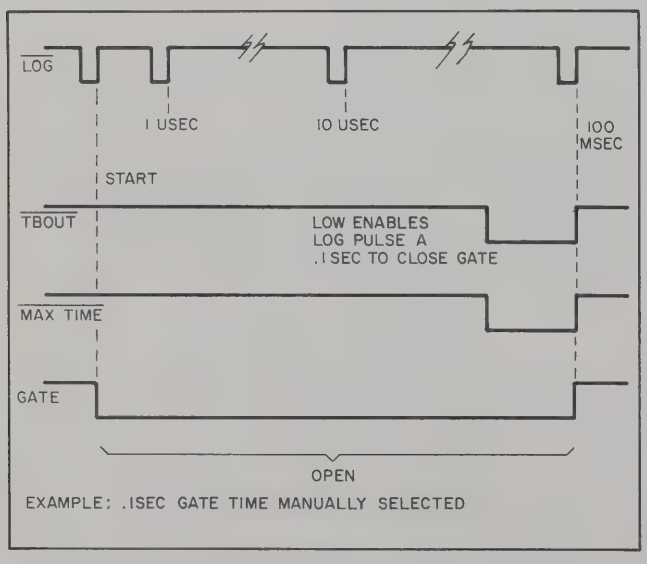


9B-4-15. The eight-decade dividers and the logic to control LOG and TIME BASE OUTPUT are all contained in a single MOS-LSI Integrated Circuit in the 5300A mainframe.

9B-4-16. The main gate which controls the flow of F1 into the counting decades, is opened by the Start Pulse and is closed by one of the other eight Log Pulses. The closing can be enabled by either of two lines going to a low state, "9" and MAX TIME.

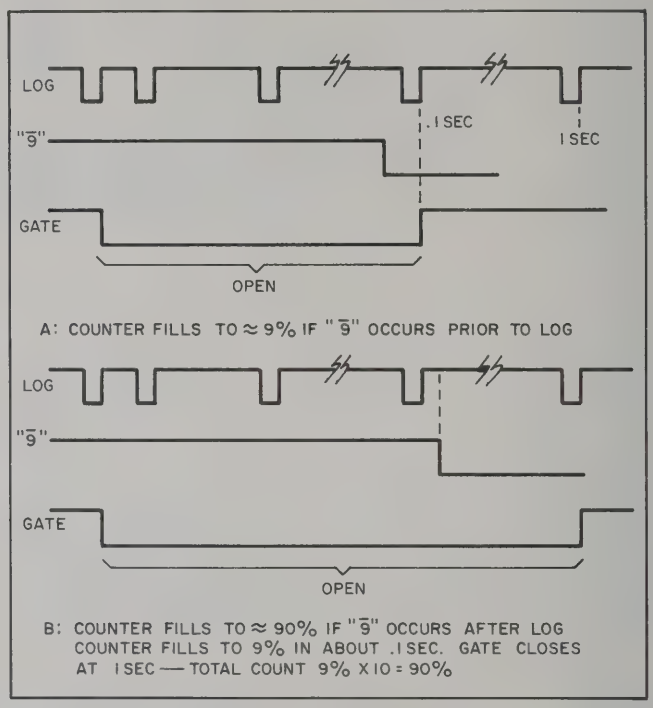
9B-4-17. MANUAL GATE SELECTION. Manually selecting 10s, 1s, or .1s gate times, generates an appropriate code which programs the time base output so that immediately preceding the correct LOG pulse, the TIME BASE OUTPUT goes low (see Figure 9B-4-3). MAX TIME is immediately pulled low by the 5302A through Q3 and U12A and enables the closing of main gate. The next LOG pulse closes the Main Gate and terminates the measurement.

Figure 9B-4-3. Manual Gate Selection



9B-4-18. AUTO GATE Selection. In automatic mode (Timing shown in Figure 9B-4-4) the control line "9" is enabled (forced high state is removed), and the counting cycle starts as in manual gate selection. When the display reaches 9% of capacity, 090000 counts, the "9" line goes low, enabling gate closing on the next LOG pulse. This AUTO feature means that the display will be from 9% to 90% full; 9% if "9" goes low *just before* a LOG pulse and 90% if it occurs *just after* a LOG pulse. To prevent the gate time in AUTO from becoming excessively long with low input frequencies, a 1 second maximum is placed on it, by coding 1 second into the TB OUTPUT. Thus, on signals from 10 Hz to 900,000 Hz, the gate time is 1 sec; from 900,001 Hz to 9.0 MHz the gate time is .1 sec, and above 9.0 MHz the gate time is .01 sec.

Figure 9B-4-4. AUTO GATE Selection



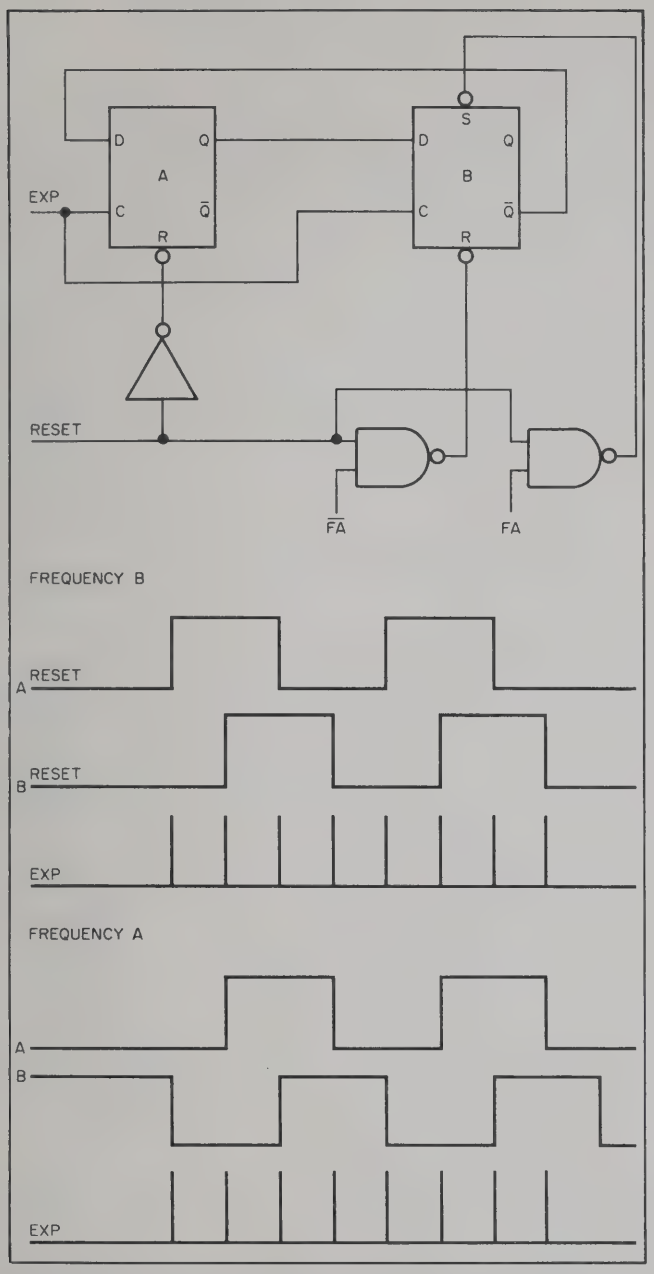
9B-4-19. In automatic operation (AUTO), the gate time is not known until the end of the measurement; the proper decimal point or units annunciators must then be determined. The length of the gate time is determined by counting the EXPONENT signal, which is the "LOG" signal that occurs while the gate is open (i.e., LOG without the start pulse). The exponent is counted by the 4-bit ripple counter consisting of U22A and U22B.

9B-4-20. The 5302A has four possible gate times; .01 second, .1 second, 1 second and 10 seconds. The .01, .1 and 1 second times are available in AUTO or "manual" positions. The 10 second gate-time is available only in "manual" position (10 S).

9B-4-21. The outputs of the exponent counter are stored in the exponent storage latches U21A,B during the measurement cycle. The outputs of these latches are then used in decoding.

9B-4-22. All frequency-related decimal point and units information is derived from the four-state exponent counter U22A and B (see Figure 9B-4-5). The channel A prescaling and the decoding used makes it necessary to reset the exponent counter to different initial states as shown in Table 9B-4-1.

Figure 9B-4-5. Exponent Counter



9B-4-23. PERIOD AND TIME INTERVAL MODES (Figures 9B-5-4 and 9B-5-5)

9B-4-24. The logic circuits for period and time interval measurement are common except for source selection. In period mode, successive leading edges of the channel B waveform open, then close, the main gate; while in Time Interval Mode, a leading edge of the channel A waveform opens the gate and the next leading edge of the channel B waveform closes the gate.

9B-4-25. In Period and Time Interval Mode the clock or timebase output is counted for one period of the input signal or for the time interval between two selected signals. The clock or timebase output signal is sent to the 5300A as F1 (A1P1(5)) through U16 F1 switch. The timebase is controlled by S2 through Time Base decoders U3A, U3B and U4A. The three-bit Time Base code is shown in Table 9B-4-1.

Table 9B-4-1. TIME BASE CODE

	TBC	TBB	TBA
1 μs	0	0	0
10 μs	0	0	1
.1 ms	0	1	0
1 ms	0	1	1
10 ms	1	0	0
.1 S	1	0	1
1 S	1	1	0
10 S	1	1	1

9B-4-26. The 5300A main gate is controlled by $\overline{\text{OPEN}}$ and $\overline{\text{CLOSE}}$ signals from U5A and U17B which gates the outputs of U7A. In Period Mode, channel B clocks U7A through U11 while in Time Interval channel A, *then* channel B clocks U7A through U11. In time interval mode U6C and U6D control the application of channel A or channel B signals to U7A. Latch U5A, D allows only one start pulse per display cycle.

9B-4-27. In period and time interval modes, the display cycle is activated by pulling $\overline{\text{MAX TIME}}$ (A1P1(17)) low through C26, R46, CR16 and U12A when the 5300A main gate closes. Units and decimal points are decoded from the TIME BASE switch positions. The $\overline{\text{LOG}}$ signal is disabled in time interval and period modes (pulled low) to prevent opening of the 5300A main gate.

9B-4-28. OPEN/CLOSE B MODE (Figure 9B-5-8)

9B-4-29. In open/close mode the channel B input is counted while the 5300A main gate is open. Channel B signal is fed to A1P1(5) as F1 signal by U16 F1 switch. The main gate is controlled by the front-panel pushbutton switch S4 through OPEN/CLOSE B latch U1B and U1C which conditions the switch signal. The OPEN/CLOSE latch signal is routed through U11 data switch and "clocks" U7A flip-flop. The output from U7A goes to U5A and U17B which generate the $\overline{\text{OPEN}}$ and $\overline{\text{CLOSE}}$ signals used to control the 5300A main gate. The $\overline{\text{TRANSFER}}$ line (A1P1 (20)) is set low to continuously transfer count information from the decades to the display. The $\overline{\text{LOG}}$ and $\overline{\text{MAX TIME}}$ lines are both inhibited; $\overline{\text{LOG}}$ is inhibited to prevent the gate from opening; $\overline{\text{MAX TIME}}$ is inhibited to prevent the display cycle from being initiated when the gate closes. The TIME BASE switch S2 is disabled through U2B and U5B in OPEN/CLOSE B mode.

9B-4-30. PER AVG B MODE (Figure 9B-5-6)

9B-4-31. Period Average function is totally automatic and operates similar to AUTO frequency mode except that the clock and input signals are interchanged. The clock signal is routed through U16 to F1 and counted, while channel B signal is fed through U12B and U15A to A1P1 (21) 1 MHz IN TB. The count will terminate after 1, 10, 100, or 1000 periods of the channel B input signals. U7B synchronizes the signal so that the first pulse is full width. The count termination is initiated either by a full display ($\bar{9}$) or by $\overline{\text{TBO}}$ signals. $\overline{\text{TBO}}$ is set so that a maximum of 1000 periods is averaged. Unit and decimal-point-decoding is from the output of the exponent counter latches U22A and B. Since period average is fully automatic, the timebase switch S2 is disabled by U2B.

9B-4-32. RATIO MODE (Figure 9B-5-7)

9B-4-33. In Ratio mode the channel B signals are counted for a given number of periods of channel A. The number selected by the time base switch position (white numbers) determines the number of periods. The channel B signal is routed to F1 by U16 and the channel A signal is routed to 1 MHz IN TB by U12B and U15A. The first pulse on the 1 MHz IN TB line is synchronized by U7B. No decimal point or units are decoded in ratio mode. F2 switch U25B and U15C, disable the clock from F2 at A1P1(7).

9B-4-34. CHECK MODE (Figure 9B-5-9)

9B-4-35. Setting the FUNCTION switch S3 to Check Mode (CHK) applies the 10 MHz clock through U16 to F1 at A1P1(5) and switches to automatic frequency mode via diode CR12. The TIMEBASE switch S2 is disabled through U5B and U2B.

SECTION IX B
5302A UNIVERSAL COUNTER
SUBSECTION V
MAINTENANCE

9B-5-1. INTRODUCTION

9B-5-2. This section contains maintenance and service information for Model 5300A/5302A 50 MHz Universal Counter. Included are performance check procedures and tests to localize, isolate, and locate defective components.

9B-5-3. RECOMMENDED TEST EQUIPMENT

9B-5-4. Test equipment recommended for performance checks, maintaining, troubleshooting and servicing the 5300A/5302A 50 MHz Universal Counter is listed in Table 5-1 of 5300A portion of the manual. Test equipment with equivalent characteristics may be substituted for equipment listed.

9B-5-5. INSTRUMENT ACCESS

9B-5-6. For access to plug-on assembly, separate the 5300A from the 5302A as follows:

a. Turn ac power OFF and disconnect power cord.

b. Pull the two-side casting latches fully rearward (it is necessary to press the latch handles gently away from the center of the instrument to unlock them).

c. When latches are fully extended rearward, the 5300A and 5302A castings should be separated by about ⅛ inch.

d. Lift the 5300A gently away from the 5302A.

e. Separate 5302A 50 MHz BOARD ASSEMBLY from 5302A casting as follows (refer to Figure 9B-5-1):

1. Press rear, plastic-nylon retaining clips on each side of 5302A casting and lift the rear of the 50 MHz Board Assembly to release it from the castings

2. Press front plastic-nylon retaining clips on each side of 5302A casting and lift the front of the 50 MHz Board Assembly to release it from the casting.

3. Lift 50 MHz Board Assembly from the casting.

f. Mate the 5302A 50 MHz Board Assembly to 5300A and reapply ac power.

g. To reinstall the 50 MHz Board Assembly into the casting reverse procedure of steps d through f.

9B-5-7. PERIODIC MAINTENANCE

9B-5-8. To determine if the 5300A/5302A is operating properly within specifications, perform the In-Cabinet Performance Checks listed in Table 9B-5-1. These checks may also be used for the 5300A performance checks when the 5300A/5302A combination is used.

9B-5-9. MAINTENANCE AND REPAIR

9B-5-10. BOARD REMOVAL. When removing the printed circuit board for replacement, repair, or servicing, always remove ac power and separate the board from the casting using Paragraph 9B-5-6 steps a to e.

9B-5-11. COMPONENT REPLACEMENT. When replacing a circuit board component use a low heat soldering iron. Heat must be used sparingly as damage to the circuit foil may result. Mounting holes may be cleaned out with a toothpick while heat is applied. Connection should be cleaned with a cleaning solution after component removal and replacement.

9B-5-12. INTEGRATED CIRCUIT REPLACEMENT. Two methods are recommended for removing integrated circuits:

a. Solder Gobbler. Solder is removed from board by a soldering iron with a hollow tip connected to a vacuum source. The IC is removed intact so it may be reinstalled if diagnosis is wrong.

b. Clip Out. This method is used when an IC is proven defective. Clip leads close to case, apply heat and remove leads with long nose pliers. Clean board holes with a toothpick and cleaning solution.

9B-5-13. INSTRUMENT TROUBLESHOOTING

9B-5-14. Trouble isolation can best be accomplished by first obtaining all possible information from the controls, connectors, and indicators on the 5300A and 5302A, then logically using this information to locate the defective component. If the performance checks indicate a malfunction or if instrument operation is suspect, perform the Self-Check procedures in Table 9B-5-1. For further tests, separate the 5302A from the casting and reconnect to 5300A using Paragraph 9B-5-6 steps a to e as a guide. Operating procedures in Subsection 9B-3 can be used to help understand operation. To test the 5302A, obtain the test equipment listed in Table 5-1 of the 5300A portion of the manual

9B-5-15. Figure 9B-5-2 to Figure 9B-5-9 are troubleshooting flow diagrams for each of the eight modes of operation. Signal flow is outlined for each mode and waveform test points and voltage level test points are indicated. The waveform or voltage level for each mode is included with the figures.

9B-5-16. FREQ "A" MODE TROUBLESHOOTING

9B-5-17. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to "A"; TIME BASE to .1 S; channel A waveform switch to "⌒"; SENSITIVITY to max cw.

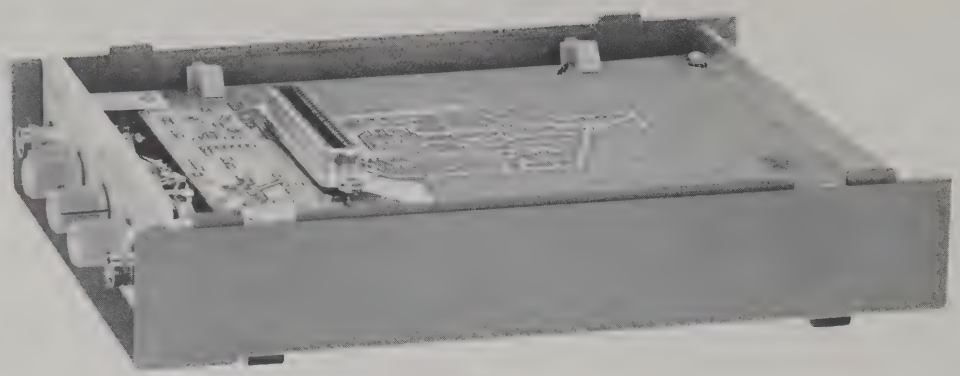
b. Connect a 651B Oscillator, 50-ohm output, set for 10 MHz, 100 mV rms to 5302A "A" 50 MHz connector.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-2.

d. 5300 display should be the same as the input frequency.

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

Figure 9B-5-1. Separation Procedure



STEP A



STEP B

9B-5-18. FREQ "B" MODE TROUBLESHOOTING

9B-5-19. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to "B"; TIME BASE to .1 S; channel B waveform switch to "∿"; SENSITIVITY to max cw.

b. Connect a 651B Oscillator, 50 ohm output, set for 10 MHz, 100 mVrms to 5302A "B" 10 MHz connector.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-3.

d. 5300 display should be the same as the input frequency.

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-20. PERIOD B MODE TROUBLESHOOTING

9B-5-21. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to PERIOD B; TIME BASE to 1 μsec; channel B waveform switch to "∿"; SENSITIVITY to max cw.

b. Connect a 651B Oscillator, 50-ohm output, set for 1 MHz, 100 mV rms to 5302A "B" 10 MHz connector.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-4.

d. 5300 display should be 000001 μs .

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-22. TIME INTERVAL MODE TROUBLESHOOTING

9B-5-23. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to T.I. A to B; TIME BASE to 1 μsec; channel A and B waveforms switches "⊓"; SENSITIVITY (both channels) to max cw.

b. Connect two 222A Pulse Generators as shown in Table 9B-5-1, Figure C. Perform Table 9B-5-1, item 6, steps b through f, except with a time interval of 2 μsec.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-5.

d. 5300 display should be 000002 μs .

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-24. PERIOD AVERAGE MODE

9B-5-25. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to PER AVG B; (TIME BASE is inoperative), channel B waveform switch to "∿"; SENSITIVITY to max cw.

b. Connect a 651B Oscillator, 50-ohm output, set for 1 MHz, 100 mV rms to 5302A "B" 10 MHz connector.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-6.

d. 5300 display should be 01.0000 μs.

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-26. RATIO MODE TROUBLESHOOTING

9B-5-27. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to RATIO $\frac{B}{A}$ X N; TIME BASE TO N = 10^3; channel A and B waveform switches to "∿"; SENSITIVITY (both channels to max cw.

b. Connect a 651B Oscillator, 50-ohm output, set for 1 MHz, 100 mV rms to 5302A "A" 50 MHz connector. Connect another 651B oscillator, 50-ohm output set for 10 MHz, 100 mV rms to 5302A "B" 10 MHz connector.

c. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-7.

d. 5300 display should be 010000.

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-28. OPEN/CLOSE (TOTALIZE) MODE TROUBLESHOOTING

9B-5-29. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to OPEN/CLOSE; (TIME BASE is inoperative) channel B waveform to "∿"; SENSITIVITY to max cw.

b. Connect a 651B Oscillator, 50-ohm output, set for 10 Hz, 100 mV rms to 5302A "B" 10 MHz connector.

c. Press 5300A RESET, press 5302A OPEN/CLOSE switch. 5300 display should accumulate at a .1 second rate.

d. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-8.

e. When using the logic probe, a High level is indicated by probe lamp "on". A Low level is indicated by probe lamp "off".

9B-5-30. CHECK MODE TROUBLESHOOTING

95-5-31. To troubleshoot the 5302A proceed as follows:

a. Set 5302A FUNCTION to CHECK; TIME BASE to AUTO.

b. Use an HP 180A Oscilloscope and an HP 10525A Logic Probe to check waveforms and voltage levels listed in Figure 9B-5-9.

c. 5300 display should be 10 MHz ±1 count.

d. When using the logic probe, a High level is indicated by probe lamp "on". A Low level indicated by probe lamp "off".

9B-5-32. If trouble is traced to the 5300A mainframe, refer to 5300A Measuring System maintenance information located in Section V of the 5300A portion of the manual.

9B-5-33. SENSITIVITY ADJUSTMENT PROCEDURE (PREFIX 1112A OR 1332A ONLY)

9B-5-34. If channel A or channel B fail to meet their sensitivity specifications, as tested in Table 9B-5-1, items 2 and 3, perform the following procedure:

a. Connect an HP 651B Oscillator, set to 100 kHz/ 50m Vrms/50 Ohms to channel A input.

b. Set 5302A SENSITIVITY (both channels) mac cw and TIME BASE to 1S; 5300A display should be 0.10000 MHz C.

c. If the display is erratic or all zeros, increase the 651B signal level until counting and display occurs.

d. Note the input signal level; obtain several ⅛W 1% resistors ranging from 10K ohms down to 500 ohms. Starting with the 10K ohm resistór, connect these resistors, one at a time, in parallel with R16.

e. Reduce the input signal level until counting stops or is erratic. Note the input signal level.

f. Remove the parallel resistor and connect another resistor of lower value across R16.

g. Reduce the input signal level until counting stops or is erratic.

h. Repeat steps a through g until a display can no longer be obtained when the parallel resistor value is decreased.

i. At this point, increase the signal level and/or the parallel resistor value until counting and display occurs within specifications.

j. Calculate the effective resistance of R16 - Parallel resistor combination and install that value in place of R16.

k. The minimum specified input signal level for 5302A channel A is 50 mV rms (typical levels may be less than 50 mV).

l. Repeat steps a through k for channel B. Display for channel B should be 100.000 kHz C.

9B-5-35. SENSITIVITY ADJUSTMENT PROCEDURE (PREFIX 1444A)

9B-5-36. Follow procedure given in paragraph 9B-5-33 except use controls A1R57 for maximum sensitivity in channel B and control A1R59 for adjusting channel A. Control A1R59 for Channel A is closest to the front panel; A1R57 for Channel B is toward the rear. The controls are centrally located along one edge of the circuit board. Resistor substitutions are not required on circuit boards with the added sensitivity controls.

Table 9B-5-1. In-Cabinet Performance Checks

1. CHECK Mode

a. Ensure 5300A OSC switch is at INT.

b. Mate 5300A to 5302A and ensure side casting latches at rear of 5300A are latched.

c. Connect ac power to 5300A ac receptacle.

d. Turn ac power "on" with 5300A SAMPLE RATE slightly cw out of OFF.

e. Set FUNCTION to CHECK; TIME BASE switch has no effect. Display should be 10.0000 MHz ± 1 count.

2. FREQ A Mode

RANGE: 10 Hz to 50 MHz.

Obtain following test equipment:

HP 651B Test Oscillator
HP 3200B VHF Oscillator
HP 11048B Feed-thru Termination

Table 5-1 in the 5300A portion of the manual and Table 9-5-1 lists equipment used; equipment with equivalent characteristics may be used.

a. Connect 651B 50-Ohm OUTPUT through the 50-Ohm feed-thru to 5302A "A-50 MHz" connector. Set 5302A FUNCTION to FREQ A, "A Waveform" Switch to " ∿ " and "A" SENSITIVITY to full cw.

b. Set 651B or 3200B to frequencies and output levels listed below: Display should be as listed.

651B or 3200B OUTPUT mV rms	651B FREQ. Hz Approximate	TIME BASE (Sec)	Approximate Display ± 1 Count ± Accuracy of Source
50 mV	10 Hz	10	000.010 kHz C
50 mV	10 kHz	10	010.000 kHz C
50 mV	100 kHz	1	0.10000 MHz C
50 mV	1 MHz	.1	01.0000 MHz C
50 mV	10 MHz	.1	10.0000 MHz C
	3200B FREQ. MHz Approximate		
100 mV	20	AUTO	20.0000 MHz
100 mV	40	AUTO	40.0000 MHz
100 mV	50	AUTO	50.0000 MHz

Table 9B-5-1. In-Cabinet Performance Checks (Continued)

3. FREQ B Mode

RANGE: 10 Hz to 10 MHz

Obtain the following test equipment:

HP 651B Test Oscillator
HP 11048B 50-Ohm Feed-thru Termination.

Table 5-1 of the 5300A portion of the manual lists equipment used; equipment with equivalent characteristics may be used.

a. Connect the 651B, set to 50 mV rms, through the 50-Ohm Feed-thru to the 5302A B 10 MHz connector.

b. Set 5302A FUNCTION to FREQ B; "B" SENSITIVITY to full cw; "B" Waveform switch to "∿".

c. Set the 651B to frequencies listed below. Display should be as listed:

651B FREQ. Hz Approximate	TIME BASE (Sec)	Approximate Display ± 1 Count ± Accuracy of Source
10 Hz	10	00.0100 kHz C
10 kHz	10	10.0000 kHz C
100 kHz	1	100.000 kHz C
1 MHz	.1	1.00000 MHz C
100 kHz	AUTO	100.000 kHz C
1 MHz	AUTO	1.00000 MHz C
10 MHz	AUTO	10.0000 MHz C

4. PULSE MEASUREMENTS Mode

Channel A and Channel B, "⎍" or "⎍" mode.

RANGE: 10 Hz to 1 MHz for Channel A. 10 Hz to 1 MHz for Channel B.

PULSE WIDTH: 50 nsec minimum.

Obtain the following test equipment:

HP Model 222A Pulse Generator
HP Model 11048B 50-Ohm Feed-thru Termination
HP Model 180A Oscilloscope
BNC Tee Connector.

a. Connect equipment as shown in Figure A.

b. Set 222A for "+" PULSE POLARITY; 50 nsec pulse width; 150 mV p-p (low duty cycle).

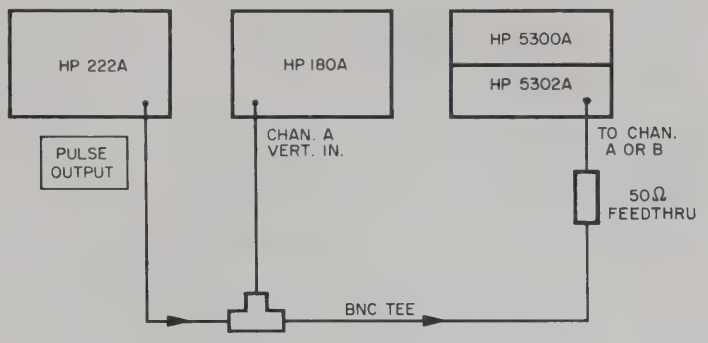
c. Monitor 222A pulse output with oscilloscope and set REP RATE for 10 Hz.

NOTE

For frequencies above 1 MHz slide switch S1 to "∿" position. A low duty cycle rate is required when making measurements in plus or minus pulse mode.

Table 9B-5-1. In-Cabinet Performance Checks (Continued)

Figure A. Connections for Pulse Measurements



d. Set 5302A SENSITIVITY to maximum ccw, Waveform Switch to "⎍", FUNCTION to FREQ A; TIME BASE to AUTO. Adjust SENSITIVITY cw until a stable display is obtained.

e. 5300A display should be approximately 10 Hz.

f. Repeat step d with 222A repetition rates of 10 kHz, 100 kHz, 1 MHz. The 5300A display should be the same as the 222A repetition rate setting.

g. Set 222A PULSE POLARITY to "-"; set Channel A Waveform switch to "⎍". Repeat steps b through f.

h. For Channel B, connect the pulse signal to Channel B 10 MHz connector; set FUNCTION to FREQ B.

i. Repeat steps b through g.

5. PERIOD B Mode

RANGE: 10 Hz (.1 sec) 1 MHz (1 μsec) Channel B only.

Obtain the following test equipment:

HP Model 651B Test Oscillator
HP Model 11048B 50-Ohm Feed-thru Termination
HP Model 180A Oscilloscope
BNC Tee Connector.

a. Connect equipment as shown in Figure B.

Figure B. Connections for Period B Measurements

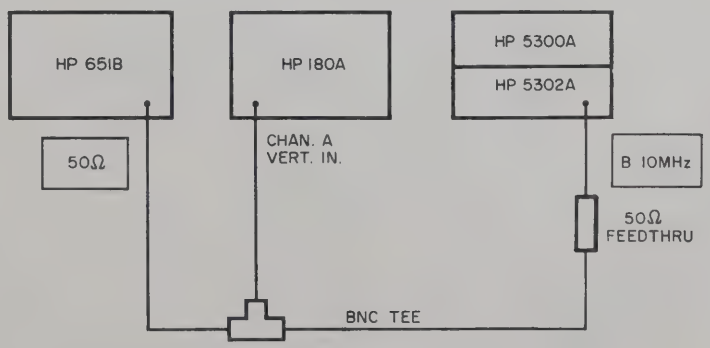


Table 9B-5-1. In-Cabinet Performance Checks (Continued)

b. Set 5302A controls as follows:

1. FUNCTION to PERIOD B.
2. TIME BASE to 1 μs.
3. Channel B Waveform Switch to " $\sim$ ".
4. Channel B SENSITIVITY to full ccw.

c. Monitor the oscilloscope and set 651B controls for 10 Hz, 100 mV rms output.

d. Adjust 5302A Channel B SENSITIVITY cw for a stable display; display should be approximately 100000 μs, C.

e. Monitor oscilloscope and set 651B for following frequencies: Display should be as listed.

651B	5300A/5302A
10 kHz	000100 μs
100 kHz	000010 μs
1 MHz	000001 μs

NOTE

For increase in resolution, adjust 5302A TIME BASE to .1 μsec.

6. TIME INTERVAL Mode

RANGE: 500 nsec to 1000 seconds.

Obtain the following test equipment:

HP Model 222A Pulse Generator (2 required).
HP Model 11048B 50-Ohm Feed-thru Termination (2 required).
HP Model 180A Oscilloscope.
BNC Tee Connectors, (3 required).

a. Connect equipment as shown in Figure C.

Figure C. Connections for Time Interval Measurements

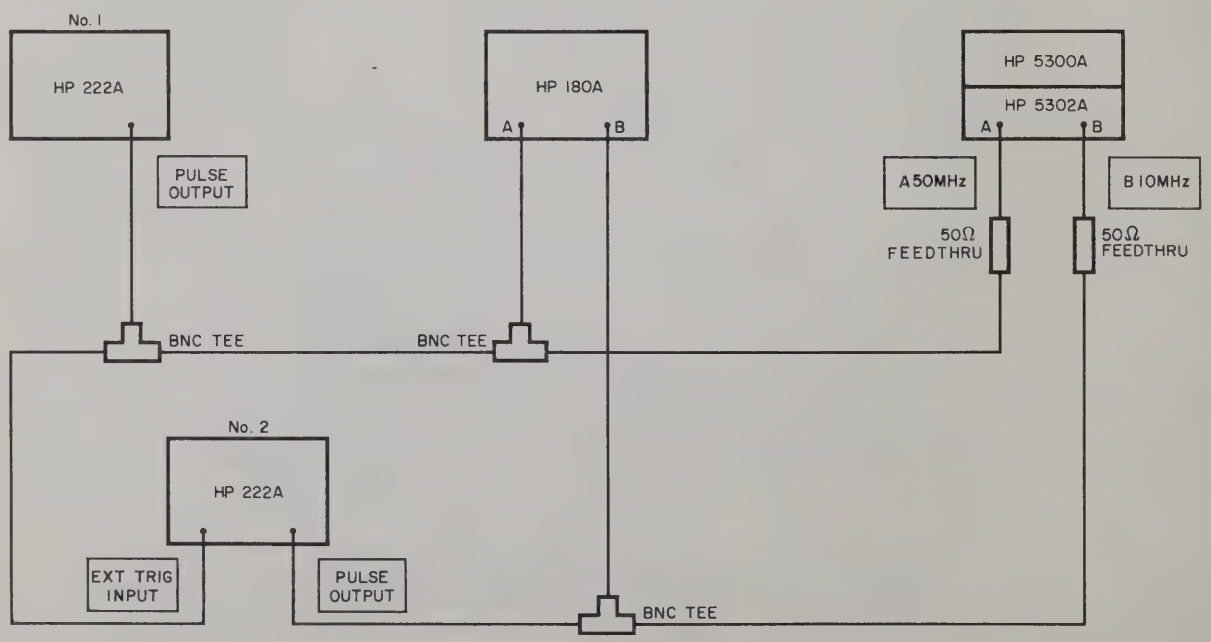


Table 9B-5-1. In-Cabinet Performance Checks (Continued)

b. While monitoring generator No. 1 output with oscilloscope, set No. 1 generator controls as follows:

1. REP RATE to 1k-10k with adjustment centered.
2. PULSE WIDTH for .2 μsec pulse at 5V amplitude.
3. PULSE POLARITY to +.

c. While monitoring generator No. 2 output with oscilloscope, set No. 2 generator controls as follows:

1. REP RATE to MAN/EXT +.
2. PULSE POLARITY to +.
3. PULSE WIDTH for .2 μsec pulse at 5V amplitude.
4. PULSE DELAY for .5 μsec.

d. Set Oscilloscope DISPLAY control to A + B to monitor No. 2 pulse position.

e. Set 5302A controls as follows:

1. SENSITIVITY (both channels) full cw.
2. Waveform switches (both channels) to "⎍ ".
3. FUNCTION to T.I. A to B.
4. TIME BASE to PERIOD/T.I. .1 μsec.

f. 5302A should display 00000.5 μsec ±1 count; verify time interval with oscilloscope while monitoring oscilloscope.

g. While monitoring oscilloscope, adjust No. 2 generator PULSE DELAY for time intervals from .5 μsec to 150 μsec. 5300A Display should be the same as oscilloscope display.

h. Set No. 1 generator REP RATE to 100-1k and adjustment centered.

i. While monitoring oscilloscope, adjust No. 2 generator PULSE DELAY for time intervals from 150 μsec to 2000 μsec. 5300A display should be the same as oscilloscope display.

j. Set No. 1 generator REP RATE to 10-100 and adjustment full ccw.

k. While monitoring oscilloscope, adjust No. 2 generator PULSE DELAY for time intervals from 2000 μsec to 6000 μsec. 5300A display and oscilloscope display should indicate the same time intervals.

NOTE

Measurement resolution may be adjusted from .1 μsec to 1 msec with the TIME BASE PERIOD/T.I. switch.

Table 9B-5-1. In-Cabinet Performance Checks (Continued)

7. PERIOD AVG B Mode

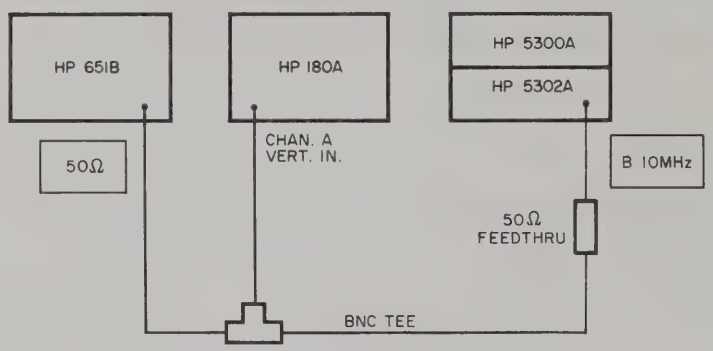
RANGE: 10 Hz (.1 sec) to 1 MHz (1 μsec).

Obtain the following test equipment:

HP Model 651B Test Oscillator.
HP Model 11048B 50-Ohm Feed-thru Termination.

a. Connect equipment as shown in Figure D.

Figure D. Connections for Period Average Measurements



b. Set 5302A controls as follows:

1. FUNCTION to PER AVG B.
2. Channel B Waveform switch to "∿ ".
3. Channel B SENSITIVITY to full ccw.

c. Monitor the oscilloscope and set 651B controls for 10 Hz, 100 mV rms output.

d. Adjust 5302A Channel B SENSITIVITY cw for a stable display; display should be approximately * 00.0000 M S C, (* = OVERFLOW) (100 msec).

e. Monitor the oscilloscope and set 651B for the following frequencies; display should be as listed.

651B	5300A/5302A
10 kHz	100.000 μs C
100 kHz	10.0000 μs C
1 MHz	01.0000 μs C

NOTE

Periods averaged automatically selected to provide maximum resolution.

Table 9B-5-1. In-Cabinet Performance Checks (Continued)

8. RATIO Measurements

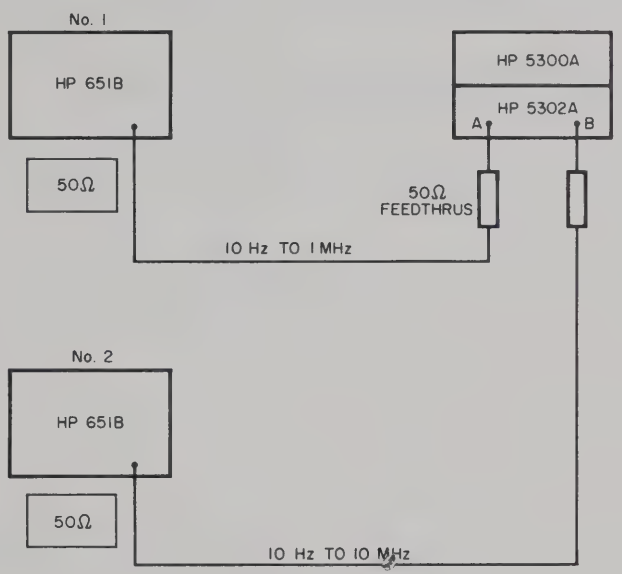
RANGE: Channel A: 10 Hz to 1 MHz.
Channel B: 10 Hz to 10 MHz.

Obtain the following test equipment:

HP Model 651B Test Oscillator (2 required).
HP Model 11048B 50-Ohm Feed-thru Termination (2 required).

a. Connect equipment as shown in Figure E.

Figure E. Ratio Measurement Equipment Connections



b. Set No. 1 oscillator to 10 Hz; verify frequency using Channel B of 5302A.

c. Set No. 2 oscillator to 10 Hz; verify frequency using Channel B of 5302A.

d. Set 5302A controls as follows:

1. Channel A: SENSITIVITY to full cw. Waveform switch to " ∿ ".
2. Channel B: SENSITIVITY to full cw. Waveform switch to " ∿ ".
3. FUNCTION to RATIO $\frac{B}{A}$ X N.
4. TIME BASE to N = 10 (white).

e. 5300A display should be 000010 C; divide display by "N" setting of 10. Ratio is 1:1.

f. Set No. 1 generator to 1 MHz and No. 2 generator to 10 MHz. Display should be 000100 C; divide display by "N" setting of 10. Ratio is 10:1.

NOTE

Ratio Multiplier setting may be set to 10 through 10^7. Measurement time is proportional to N.

Table 9B-5-1. In-Cabinet Performance Checks (Continued)

9. Totalizing (OPEN/CLOSE B) Measurements

Obtain the following test equipment:

HP Model 651B Test Oscillator.
HP Model 11048B 50-Ohm Feed-thru Termination.

a. Connect 651B 50-Ohm output, set to 10 Hz at 100 mV rms, to 5302A Channel B 10 MHz connector.

b. Set Channel B SENSITIVITY full ccw and set Channel B Waveform switch to "∿ ".

c. Set FUNCTION switch to OPEN/CLOSE B.

d. TIME BASE switch may be in any position since it is inoperative in Totalizing mode. Instrument gate is controlled by operator when OPEN/CLOSE B pushbutton is pressed.

e. Press OPEN/CLOSE B switch; 5300A C lamp will turn on; adjust Channel B SENSITIVITY cw until 5300A display starts accumulating.

f. To stop 5300A from accumulating, press OPEN/CLOSE B. To continue accumulation from the number displayed press OPEN/CLOSE B, otherwise press RESET to clear display.

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 5300A/5302A
50 MHz Universal Counter

Test Performed by _____

Serial No. ____-_____

Date _____

Description	Check
1. CHECK Mode. Display is 10 MHz ±1 Count.	☐
2. FREQ A Mode. 10 Hz to 50 MHz.	☐
3. FREQ B Mode. 10 Hz to 10 MHz.	☐
4. PULSE MEASUREMENTS Mode. Channel A and B; "⊓", "⊔" 10 Hz to 1 MHz Channel A. "⊓", "⊔" 10 Hz to 1 MHz Channel B.	☐ ☐
5. PERIOD B Mode. 10 Hz (.1 sec) to 1 MHz (1 μsec).	☐
6. TIME INTERVAL Mode. 500 nsec to 1000 seconds (tested to 6000 μsec).	☐
7. PER AVG B Mode. 10 Hz (.1 sec) to 1 MHz (1 μsec).	☐
8. RATIO Mode. Channel A. 10 Hz to 1 MHz. Channel B. 10 Hz to 10 MHz.	☐
9. Totalizing (OPEN/CLOSE B) Controlled accumulation.	☐

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 5300A/5302A
50 MHz Universal Counter

Test Performed by _____

Serial No. ____-_____

Date _____

Description	Check
1. CHECK Mode.	
Display is 10 MHz ± 1 Count.	☐
2. FREQ A Mode.	
10 Hz to 50 MHz.	☐
3. FREQ B Mode.	
10 Hz to 10 MHz.	☐
4. PULSE MEASUREMENTS Mode.	
Channel A and B;	
"⊓", "⊔" 10 Hz to 1 MHz Channel A.	☐
"⊓", "⊔" 10 Hz to 1 MHz Channel B.	☐
5. PERIOD B Mode.	
10 Hz (.1 sec) to 1 MHz (1 μsec).	☐
6. TIME INTERVAL Mode.	
500 nsec to 1000 seconds (tested to 6000 μsec).	☐
7. PER AVG B Mode.	
10 Hz (.1 sec) to 1 MHz (1 μsec).	☐
8. RATIO Mode.	
Channel A. 10 Hz to 1 MHz.	☐
Channel B. 10 Hz to 10 MHz.	
9. Totalizing (OPEN/CLOSE B)	
Controlled accumulation.	☐

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

TP1	H	Pulses Low when Time Base switch position "rocked".
TP2	H	Pulses Low when Time Base switch position "rocked".
TP3	H	Pulses Low when Function switch changed to FREQ B.
TP4	H	Goes Low when Function switch changed from FREQ A.
TP5	H	Pulses Low when Time Base switch is "rocked".
TP6	L	Pulses High when Function switch is "rocked".
TP7	L	Pulses High when Function switch is "rocked".
TP8	H (Dim)	Pulsing Low at a .1 second rate. Pulse rate decreases as Time Base switch is changed.
TP9	H	Pulses Low at a .1 second rate. Pulse rate decreases as Time Base switch is changed.
TP10	H	
TP11	L	
TP12	H	

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. Oscillator set to 10 MHz, 100 mVrms/50Ω. See Paragraph 9B-5-16.

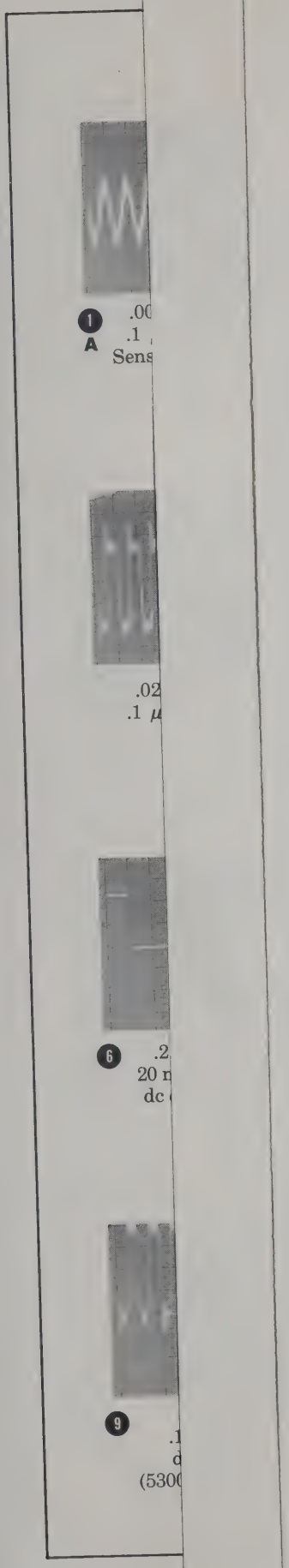


Figure 9B-5-2
FREQ A MODE TROUBLESHOOTING CHART

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

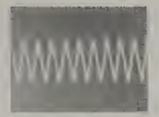
TP1	H	Pulses Low when Time Base switch position "rocked".
TP2	H	Pulses Low when Time Base switch position "rocked".
TP3	H	Pulses Low when Function switch changed to FREQ B.
TP4	H	Goes Low when Function switch changed from FREQ A.
TP5	H	Pulses Low when Time Base switch is "rocked".
TP6	L	Pulses High when Function switch is "rocked".
TP7	L	Pulses High when Function switch is "rocked".
TP8	H (Dim)	Pulsing Low at a .1 second rate. Pulse rate decreases as Time Base switch is changed.
TP9	H	Pulses Low at a .1 second rate. Pulse rate decreases as Time Base switch is changed.
TP10	H	
TP11	L	
TP12	H	

OSCILLOSCOPE:

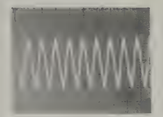
All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

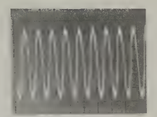
Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. Oscillator set to 10 MHz, 100 mVrms/50Ω. See Paragraph 9B-5-16.



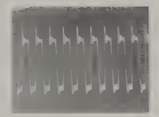
1A .005 V/cm, .1 μsec/cm. Sens. Max. cw.



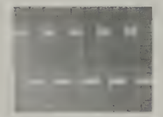
1B .005 V/cm, .1 μsec/cm. Sens. Max. ccw.



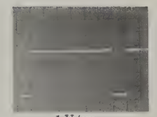
2 .01 V/cm, .1 μsec/cm.



.02 V/cm, .1 μsec/cm.



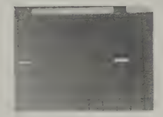
4 .02 V/cm, .5 μsec/cm.



5 .1 V/cm, 20 msec/cm, dc coupled, −slope.



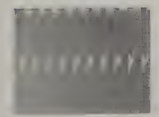
6 .2 V/cm, 20 msec/cm, dc coupled.



7 .1 V/cm, 20 msec/cm, dc coupled, − slope.



8 .1 V/cm, .1 μsec/cm, dc coupled.



9 .1 V/cm, .1 μsec/cm, dc coupled, (5300 Sample Rate Max. cw).



10 .1 V/cm, .1 μsec/cm, dc coupled.



11 .1 V/cm, .5 μsec/cm, dc coupled, (5300 Sample Rate Max. cw).

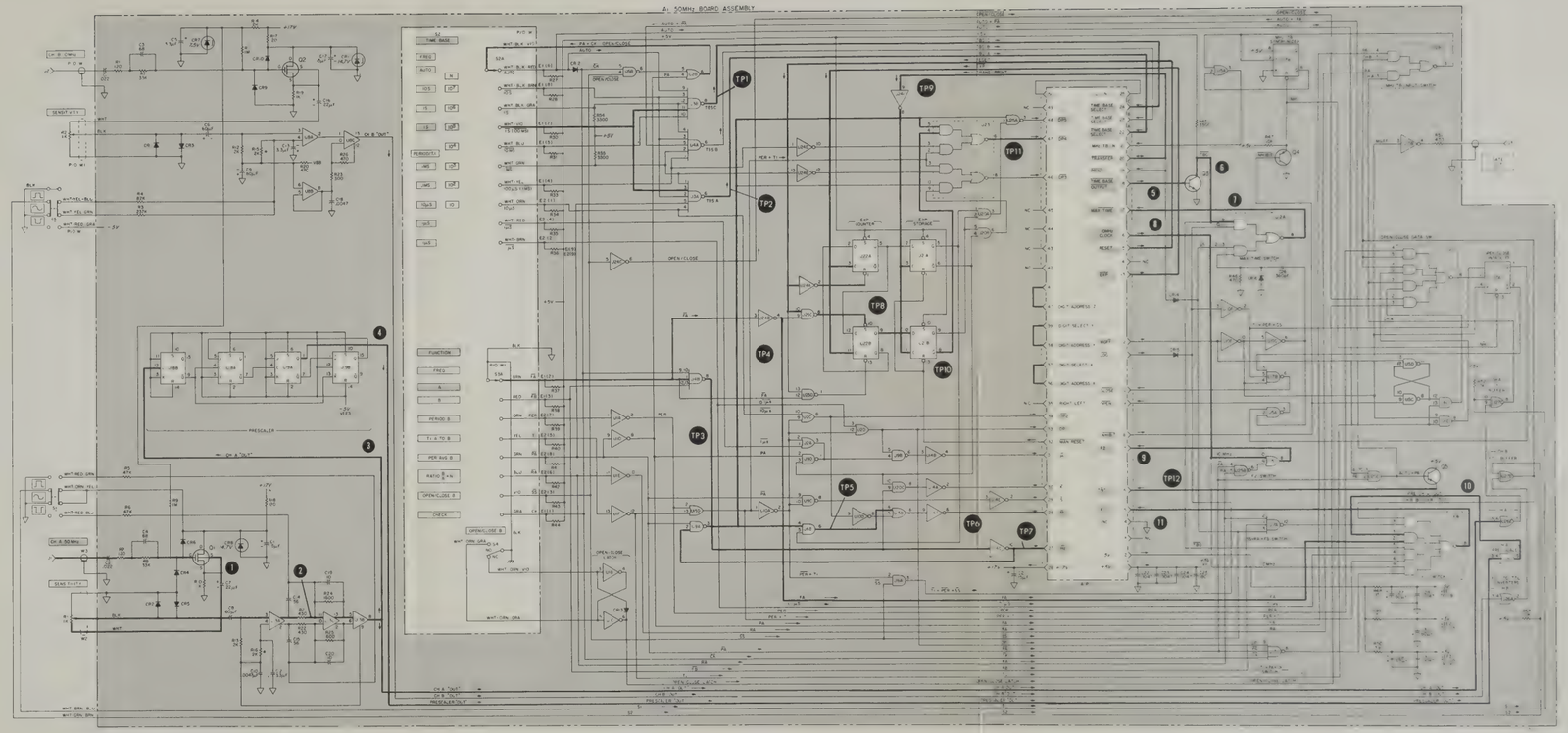


Figure 9B-5-2
FREQ A MODE TROUBLESHOOTING CHART
9B-5-15

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

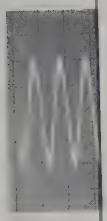
TP1	H	Pulses Low when Time Base switch is "rocked".
TP2, TP3, TP4	H	Pulses Low or goes Low when Time Base switch is "rocked".
TP5, TP6	L	Pulses High or goes High when Time Base switch is "rocked".
TP7	H	Pulses Low at a .1 second rate. Pulse rate may be varied by adjusting 5300 Sample Rate.
TP8	L	Pulses High at a .1 second rate. Pulse rate may be varied by adjusting 5300 Sample Rate.
TP9	L	Pulses High at a .1 second rate.
TP10, TP11	H	Pulses Low when 5300 RESET is pressed.
TP12	L	Pulses High when 5300 RESET is pressed.
TP13	H	

OSCILLOSCOPE:

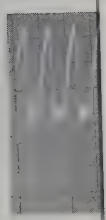
All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using an HP651B Oscillator as signal source. Oscillator set to 10 MHz, 100 mVrms/50Ω . See Paragraph 9B-5-18.



1 .00
A .1
Sens.



3 .1
.1 μ
dc c



6 .2
.1 μ
dc c

Figure 9B-5-3
FREQ B MODE TROUBLESHOOTING CHART

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

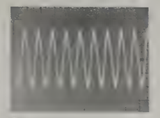
TP1	H	Pulses Low when Time Base switch is "rocked".
TP2, TP3, TP4	H	Pulses Low or goes Low when Time Base switch is "rocked".
TP5, TP6	L	Pulses High or goes High when Time Base switch is "rocked".
TP7	H	Pulses Low at a .1 second rate. Pulse rate may be varied by adjusting 5300 Sample Rate.
TP8	L	Pulses High at a .1 second rate. Pulse rate may be varied by adjusting 5300 Sample Rate.
TP9	L	Pulses High at a .1 second rate.
TP10, TP11	H	Pulses Low when 5300 RESET is pressed.
TP12	L	Pulses High when 5300 RESET is pressed.
TP13	H	

OSCILLOSCOPE:

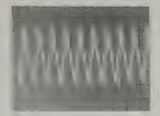
All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

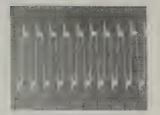
Separated from casting. Waveforms taken with 180A Oscilloscope using an HP651B Oscillator as signal source. Oscillator set to 10 MHz, 100 mVrms/50Ω. See Paragraph 9B-5-18.



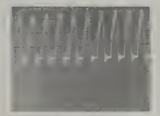
1 A .005 V/cm, .1 μsec/cm, Sens. Max. ccw.



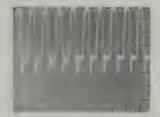
1 B .005 V/cm, .1 μsec/cm, Sens. Max. cw.



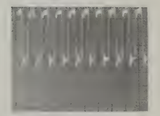
2 .02 V/cm, .1 μsec/cm



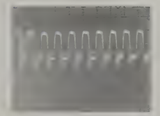
3 .1 V/cm, .1 μsec/cm, dc coupled.



4 .1 V/cm, .1 μsec/cm, dc coupled.



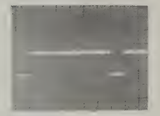
5 .1 V/cm, .1 μsec/cm, dc coupled, 5300 Sample Rate Max. cw.



6 .2 V/cm, .1 μsec/cm, dc coupled.



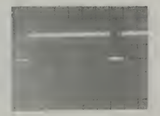
7 .2 V/cm, .1 μsec/cm, dc coupled, 5300 Sample Rate Max. cw.



8 .2 V/cm, 20 msec/cm, dc coupled, – slope.



9 .2 V/cm, 20 msec/cm, dc coupled.



10 .2 V/cm, 20 msec/cm, dc coupled, – slope.

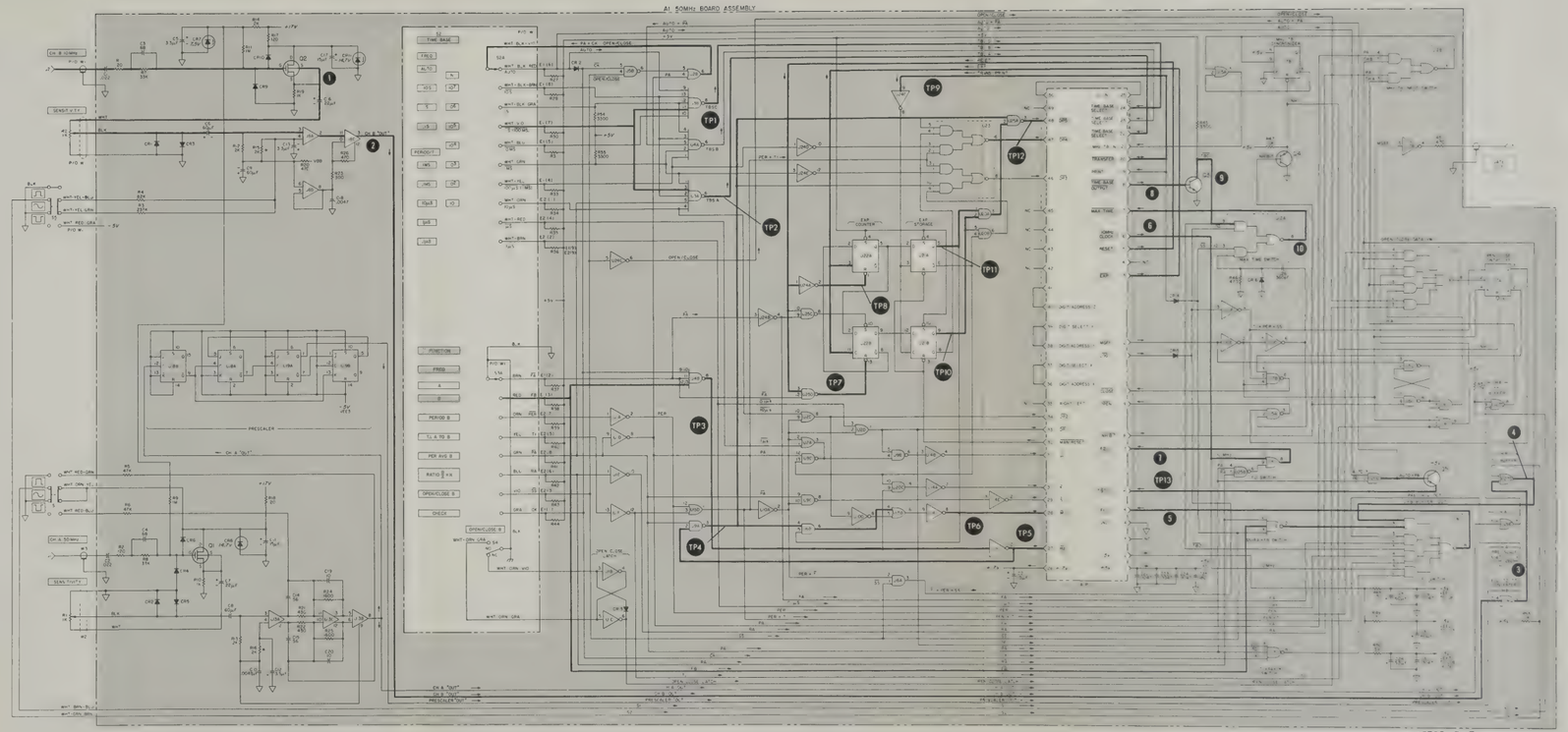


Figure 9B-5-3
FREQ B MODE TROUBLESHOOTING CHART
9B-5-17

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

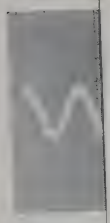
TP1	H	Pulses Low or goes Low when FUNCTION switch is "rocked".
TP2	L	Pulses High or goes High when FUNCTION switch is "rocked".
TP3	L	Pulses High or goes High when FUNCTION switch or TIME BASE switch is "rocked".
TP4	L	Pulses High or goes High when FUNCTION switch is "rocked".
TP5, TP6	H (Dim)	Rapid flashing indicates presence of signal.
TP7	H	
TP8, TP9, TP10	H (Dim)	Flash rate may be decreased by adjusting 5300 Sample Rate.

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

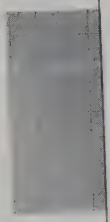
Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. Oscillator set to 1 MHz, 100 mVrms/50Ω. See Paragraph 9B-5-20.



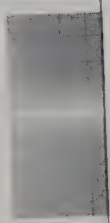
1 .01
.5 μ



4 .1
.5 μ



7 .2
.2 μ
dc c
–



9 .2
B 5 m
dc c

Figure 9B-5-4
PERIOD B MODE TROUBLESHOOTING CHART

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

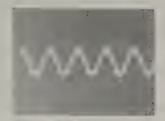
TP1	H	Pulses Low or goes Low when FUNCTION switch is "rocked".
TP2	L	Pulses High or goes High when FUNCTION switch is "rocked".
TP3	L	Pulses High or goes High when FUNCTION switch or TIME BASE switch is "rocked".
TP4	L	Pulses High or goes High when FUNCTION switch is "rocked".
TP5, TP6	H (Dim)	Rapid flashing indicates presence of signal.
TP7	H	
TP8, TP9, TP10	H (Dim)	Flash rate may be decreased by adjusting 5300 Sample Rate.

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. Oscillator set to 1 MHz, 100 mVrms/50Ω. See Paragraph 9B-5-20.



1 .01 V/cm, .5 μsec/cm.



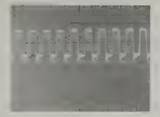
2 .02 V/cm, .5 μsec/cm.



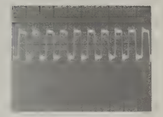
3 .1 V/cm, .5 μsec/cm.



4 .1 V/cm, .5 μsec/cm.



5 .2 V/cm, .1 μsec/cm, dc coupled.



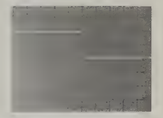
6 .2 V/cm, .1 μsec/cm, dc coupled.



7 .2 V/cm, .2 μsec/cm, dc coupled, – slope.



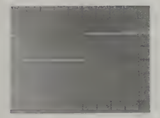
8 .2 V/cm, 5 μsec/cm, dc coupled.



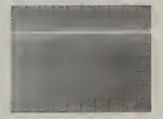
9 A .2 V/cm, .2 μsec/cm, dc coupled.



9 B .2 V/cm, 5 msec/cm, dc coupled.



10 A .2 V/cm, 2 μsec/cm, dc coupled, – slope.



10 B .2 V/cm, 5 msec/cm, dc coupled, – slope.

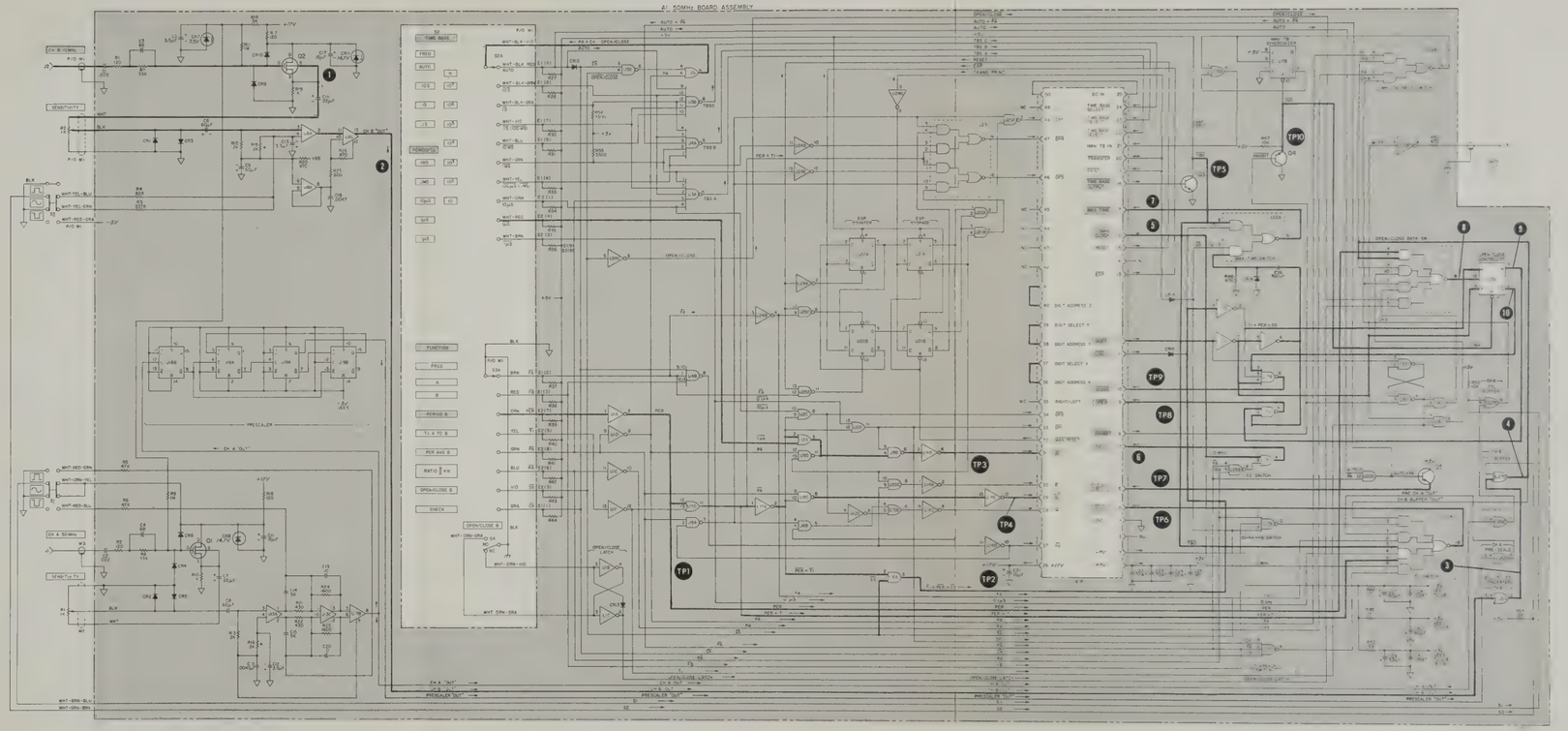


Figure 9B-5-4
PERIOD B MODE TROUBLESHOOTING CHART
9B-5-19

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

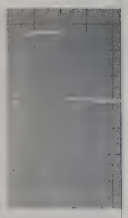
TP1	L	
TP2	L	Goes High when FUNCTION switch set to PER AVG B.
TP3	L	Goes High when FUNCTION switch set to PER AVG B or when TIME BASE set to 10 μsec.
TP4	H	Pulses Low or goes Low when FUNCTION switch is "rocked".
TP5	L	Pulses High or goes High when FUNCTION switch is "rocked".
TP6	L	Pulses High or goes High when FUNCTION switch is "rocked". Goes High when TIME BASE switch is "rocked".
TP7	L	Pulses High or goes High when FUNCTION switch or when TIME BASE switch is "rocked".
TP8	L	Pulses High when FUNCTION switch is "rocked".
TP9	H (Dim)	Flash-on rate may be decreased by adjusting 5300 Sample Rate.
TP10	H (Dim)	Flash-on rate may be decreased by adjusting 5300 Sample Rate.
TP11, TP12, TP13	H (Dim)	Flash-on rate may be decreased by adjusting 5300 Sample Rate.
TP14	H	

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

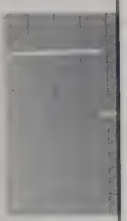
Separated from casting. Waveforms taken with 180A Oscilloscope using HP 222A Pulse Generators as signal sources. See Paragraph 9B-5-22.



1 A .05
.2 μs
Sens. M



4 A .1 V
.2 μs
Sens. M



7 .2 V
1 μsec



11 .2 V
1 μsec

Figure 9B-5-5
TIME INTERVAL A TO B MODE TROUBLESHOOTING CHART
9B-5-21

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

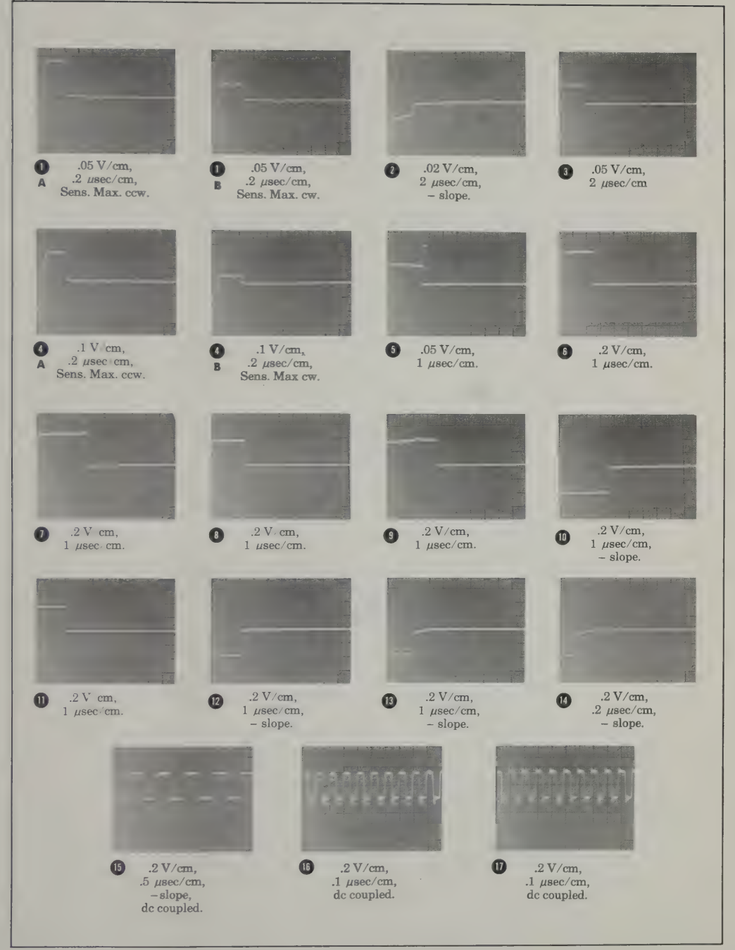
TP1	L	
TP2	L	Goes High when FUNCTION switch set to PER AVG B.
TP3	L	Goes High when FUNCTION switch set to PER AVG B or when TIME BASE set to 10 μsec.
TP4	H	Pulses Low or goes Low when FUNCTION switch is "rocked".
TP5	L	Pulses High or goes High when FUNCTION switch is "rocked".
TP6	L	Pulses High or goes High when FUNCTION switch is "rocked". Goes High when TIME BASE switch is "rocked".
TP7	L	Pulses High or goes High when FUNCTION switch or when TIME BASE switch is "rocked".
TP8	L	Pulses High when FUNCTION switch is "rocked".
TP9	H (Dim)	Flash-on rate may be decreased by adjusting 5300 Sample Rate.
TP10	H (Dim)	Flash-on rate may be decreased by adjusting 5300 Sample Rate.
TP11, TP12, TP13	H (Dim)	Flash-on rate may be decreased by adjusting 5300 Sample Rate.
TP14	H	

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using HP 222A Pulse Generators as signal sources. See Paragraph 9B-5-22.



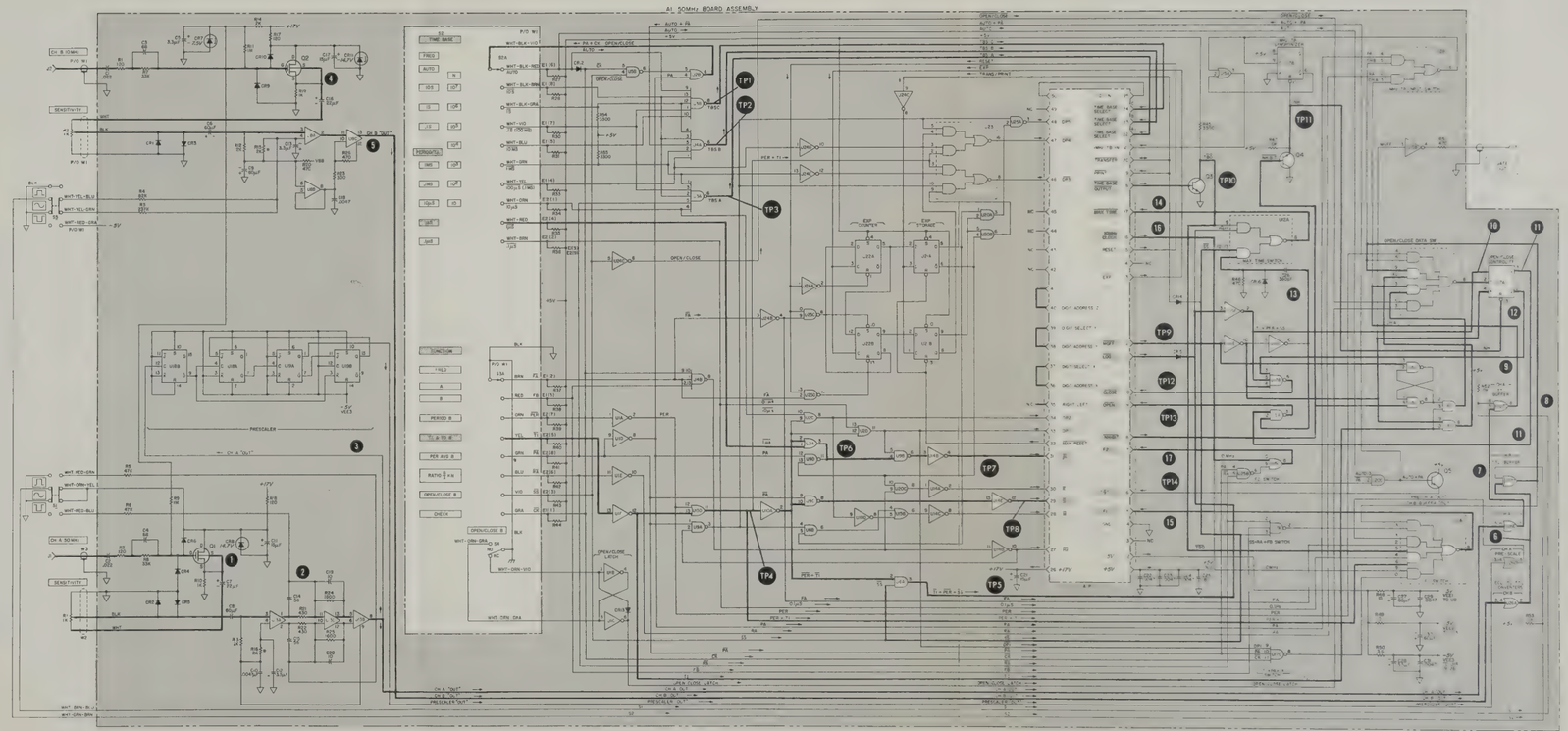


Figure 9B-5-5
TIME INTERVAL A TO B MODE TROUBLESHOOTING CHART
9B-5-21

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

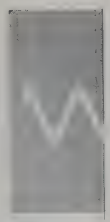
TP1	H	Flashes Low when FUNCTION switch is "rocked".
TP2, TP3	H	Goes Low when FUNCTION switch is "rocked".
TP4, TP5, TP6, TP7	H (Dim)	Flash-on rate may be decreased by adjusting 5300 Sample Rate.
TP8, TP9, TP10, TP11	L	
TP12	H	Goes Low when FUNCTION switch is "rocked".
TP13	L	Flashes High when FUNCTION switch is "rocked".

OSCILLOSCOPE:

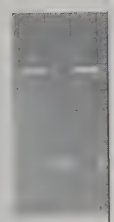
All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. See Paragraph 9B-5-24.



1 .01
.5 A



4 .1
.5 A



7 .1
A .5 m
dc
–



8 .1
B 5 m
dc
–

Figure 9B-5-6
PERIOD AVERAGE B MODE TROUBLESHOOTING CHART

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

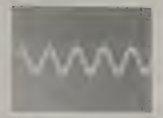
TP1	H	Flashes Low when FUNCTION switch is "rocked".
TP2, TP3	H	Goes Low when FUNCTION switch is "rocked".
TP4, TP5, TP6, TP7	H (Dim)	Flash-on rate may be decreased by adjusting 5300 Sample Rate.
TP8, TP9, TP10, TP11	L	
TP12	H	Goes Low when FUNCTION switch is "rocked".
TP13	L	Flashes High when FUNCTION switch is "rocked".

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. See Paragraph 9B-5-24.



1 .01 V/cm, .5 μsec/cm.



2 .02 V/cm, .5 μsec/cm.



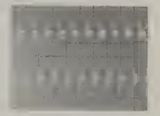
3 .1 V/cm, .5 μsec/cm.



4 .1 V/cm, .5 μsec/cm.



5 .1 V/cm, .1 μsec/cm.



6 .1 V/cm, .1 μsec/cm.



7A .1 V/cm, .5 msec/cm, dc coupled, – slope.



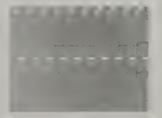
7B .1 V/cm, 5 msec/cm, dc coupled, – slope.



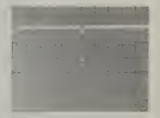
8A .1 V/cm, .1 msec/cm, dc coupled, – slope.



9B .1 V/cm, 5 msec/cm, dc coupled, – slope.



9 .1 V/cm, 1 μsec/cm, dc coupled.



10 .2 V/cm, 5 msec/cm, dc coupled, – slope.

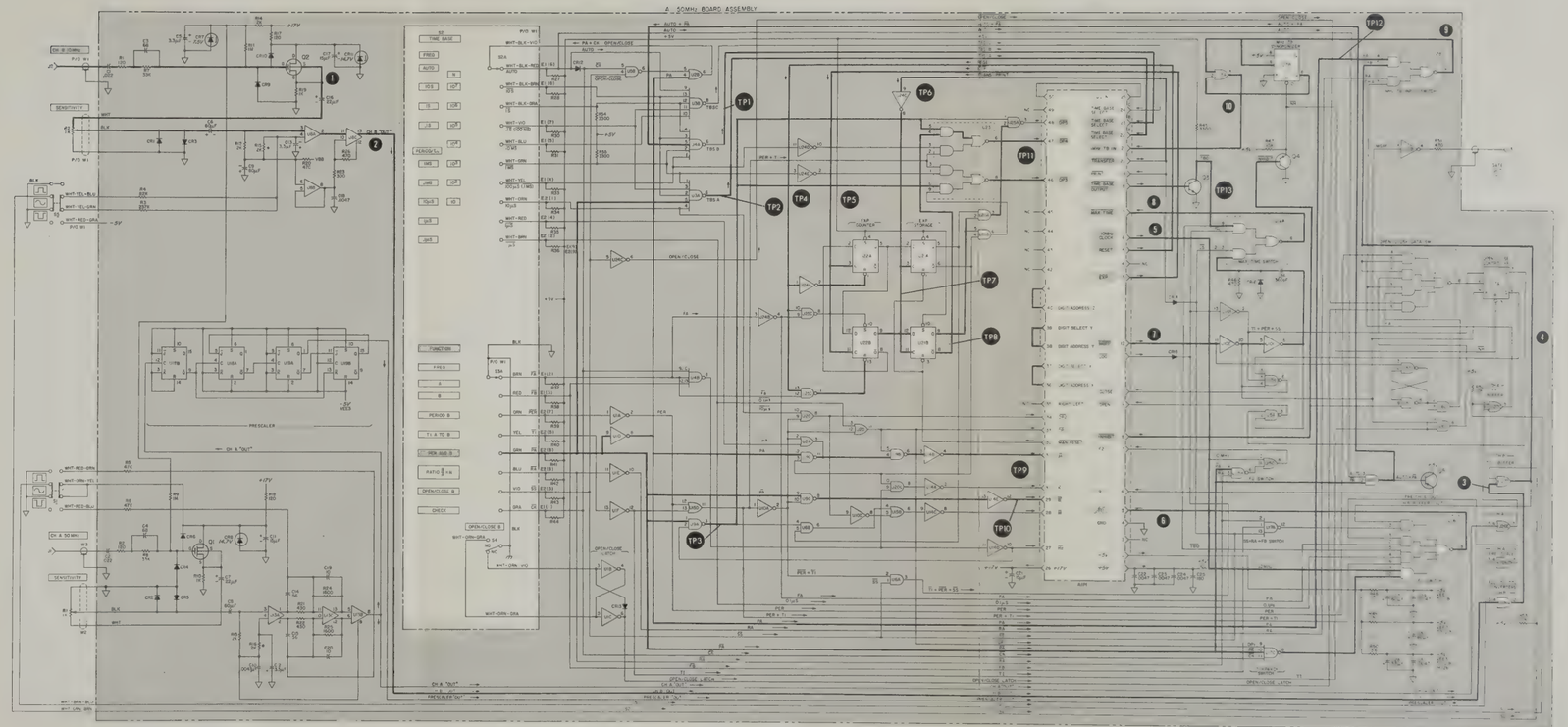


Figure 9B-5-6
PERIOD AVERAGE B MODE TROUBLESHOOTING CHART
9B-5-23

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

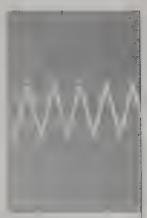
TP1	H	Goes Low when TIME BASE switch is "rocked". Goes Low or pulses Low when FUNCTION switch is "rocked".
TP2	H	Pulses Low or goes Low when TIME BASE switch is "rocked".
TP3, TP4	H (Dim)	Flash rate may be decreased by adjusting 5300 Sample rate. Goes Low when 5300 RESET is pressed.
TP5	H	

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. See Paragraph 9B-5-26.



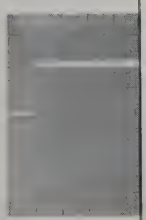
1 A .01 V/
.1 μsec
5300 Sa
Rate



4 .02 V/
1 μsec



8 .1 V/
.1 μsec



12 A .2 V/
1 msec
dc cou
– slo

Figure 9B-5-7
RATIO MODE TROUBLESHOOTING CHART

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

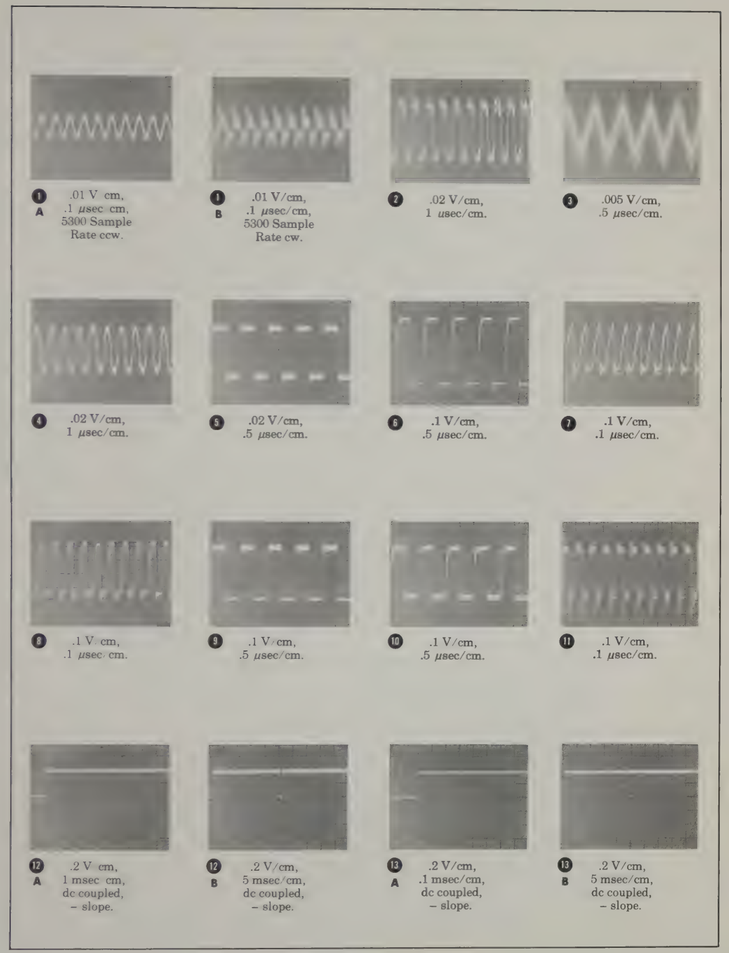
TP1	H	Goes Low when TIME BASE switch is "rocked". Goes Low or pulses Low when FUNCTION switch is "rocked".
TP2	H	Pulses Low or goes Low when TIME BASE switch is "rocked".
TP3, TP4	H (Dim)	Flash rate may be decreased by adjusting 5300 Sample rate. Goes Low when 5300 RESET is pressed.
TP5	H	

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. See Paragraph 9B-5-26.



1 A .01 V/cm, .1 μsec/cm, 5300 Sample Rate ccw.

1 B .01 V/cm, .1 μsec/cm, 5300 Sample Rate cw.

2 .02 V/cm, 1 μsec/cm.

3 .005 V/cm, .5 μsec/cm.

4 .02 V/cm, 1 μsec/cm.

5 .02 V/cm, .5 μsec/cm.

6 .1 V/cm, .5 μsec/cm.

7 .1 V/cm, .1 μsec/cm.

8 .1 V/cm, .1 μsec/cm.

9 .1 V/cm, .5 μsec/cm.

10 .1 V/cm, .5 μsec/cm.

11 .1 V/cm, .1 μsec/cm.

12 A .2 V/cm, 1 msec/cm, dc coupled, – slope.

12 B .2 V/cm, 5 msec/cm, dc coupled, – slope.

13 A .2 V/cm, .1 msec/cm, dc coupled, – slope.

13 B .2 V/cm, 5 msec/cm, dc coupled, – slope.

Figure 9B-5-7
RATIO MODE TROUBLESHOOTING CHART

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

TP1	L	Flashes High whenever OPEN/CLOSE switch is pressed.
TP2	H	Flashes Low whenever 5300 RESET is pressed.
TP3	H	Flashes Low whenever OPEN/CLOSE switch is pressed.
TP4		High whenever counter is accumulating. Low when counter is not accumulating.
TP5		Low whenever counter is accumulating; High when counter is not accumulating.
TP6	H	Flashes Low when count is initiated.
TP7	H	Flashes Low when count is terminated or when 5300 RESET is pressed.
TP8	L	

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. See Paragraph 9B-5-28.

Figure 9B-5-8
OPEN/CLOSE (TOTALIZE) MODE TROUBLESHOOTING CHART
9B-5-27

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

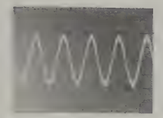
TP1	L	Flashes High whenever OPEN/CLOSE switch is pressed.
TP2	H	Flashes Low whenever 5300 RESET is pressed.
TP3	H	Flashes Low whenever OPEN/CLOSE switch is pressed.
TP4		High whenever counter is accumulating. Low when counter is not accumulating.
TP5		Low whenever counter is accumulating; High when counter is not accumulating.
TP6	H	Flashes Low when count is initiated.
TP7	H	Flashes Low when count is terminated or when 5300 RESET is pressed.
TP8	L	

OSCILLOSCOPE:

All waveforms ac coupled (except where noted) through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope using an HP 651B Oscillator as signal source. See Paragraph 9B-5-28.



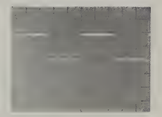
1 .005 V/cm,
50 msec/cm,
Sens. cw.



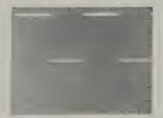
2 .05 V/cm,
20 msec/cm,
dc coupled.



3 .2 V/cm,
20 msec/cm,
dc coupled.



4 .2 V/cm,
20 msec/cm,
dc coupled.



5 .1 V/cm,
20 msec/cm,
dc coupled.

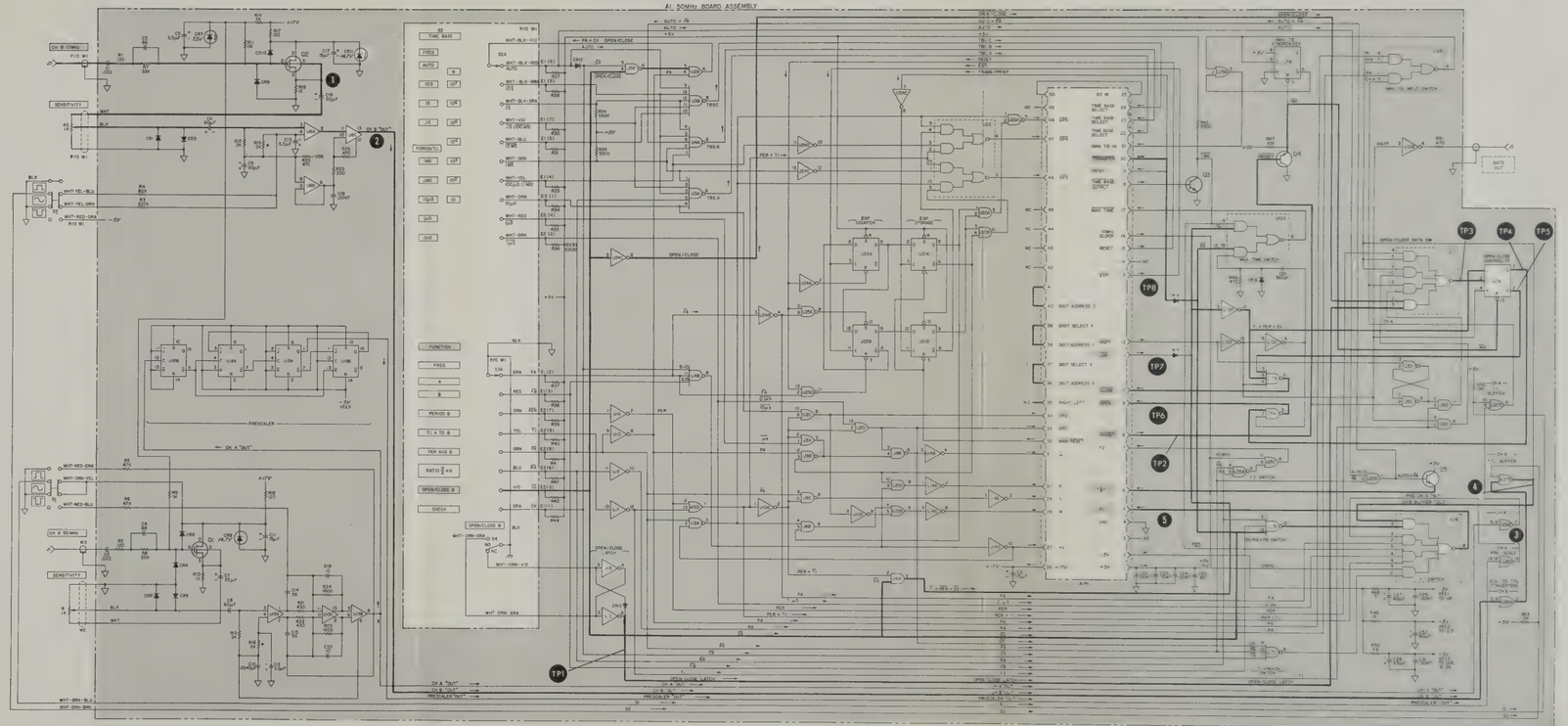


Figure 9B-5-8
OPEN/CLOSE (TOTALIZE) MODE TROUBLESHOOTING CHART
9B-5-27

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

TP1, TP2	H	Goes Low when FUNCTION switch is switched out of CHECK.
TP3	H (Dim)	Goes Low when 5300 RESET is pressed.
TP4	H	
TP5	L	Goes High when FUNCTION switch is switched out of CHECK.
TP6	L	Goes High when 5300 RESET is pressed.
TP7	L	
TP8	H	Goes Low when FUNCTION switch is switched out of CHECK.
TP9	H (Dim)	Goes Low when 5300 RESET is pressed.
TP10	H (Dim)	Goes High (bright) when 5300 RESET is pressed.
TP11	L	Goes High (Dim) when FUNCTION switch is switched out of CHECK.

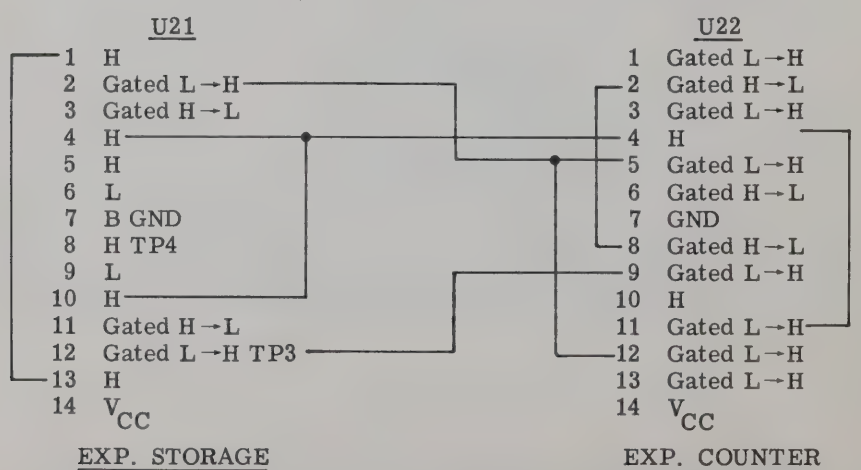
OSCILLOSCOPE:

All waveforms dc coupled through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope. See Paragraph 9B-5-30.

LOGIC CONDITIONS IN SELF CHECK MODE



All gated conditions represents frequency = 1 MHz approximately.

Figure 9B-5-9
SELF CHECK MODE TROUBLESHOOTING CHART

TEST POINTS USING HP 10525A LOGIC PROBE

H = High (lamp on)
L = Low (lamp off)

TP1, TP2	H	Goes Low when FUNCTION switch is switched out of CHECK.
TP3	H (Dim)	Goes Low when 5300 RESET is pressed.
TP4	H	
TP5	L	Goes High when FUNCTION switch is switched out of CHECK.
TP6	L	Goes High when 5300 RESET is pressed.
TP7	L	
TP8	H	Goes Low when FUNCTION switch is switched out of CHECK.
TP9	H (Dim)	Goes Low when 5300 RESET is pressed.
TP10	H (Dim)	Goes High (bright) when 5300 RESET is pressed.
TP11	L	Goes High (Dim) when FUNCTION switch is switched out of CHECK.

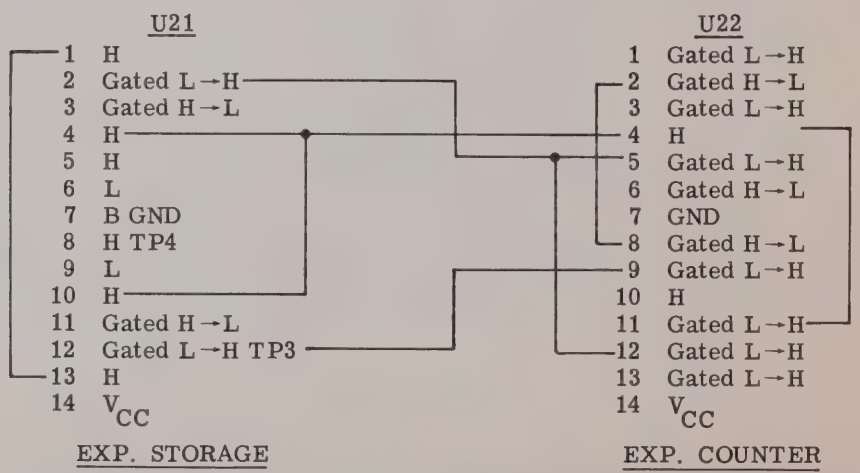
OSCILLOSCOPE:

All waveforms dc coupled through a 10:1 divider probe; + slope (except where noted), INT triggering.

5302A:

Separated from casting. Waveforms taken with 180A Oscilloscope. See Paragraph 9B-5-30.

LOGIC CONDITIONS IN SELF CHECK MODE



All gated conditions represents frequency = 1 MHz approximately.



1 .2 V/cm, .1 μsec/cm.



2 .2 V/cm, .1 μsec/cm.



3 .2 V/cm, .1 μsec/cm, 5300 Sample Rate cw.



4 .1 V/cm, 20 msec/cm, – slope.



5 .2 V/cm, 20 msec/cm, – slope.



6 .2 V/cm, .5 μsec/cm, – slope.

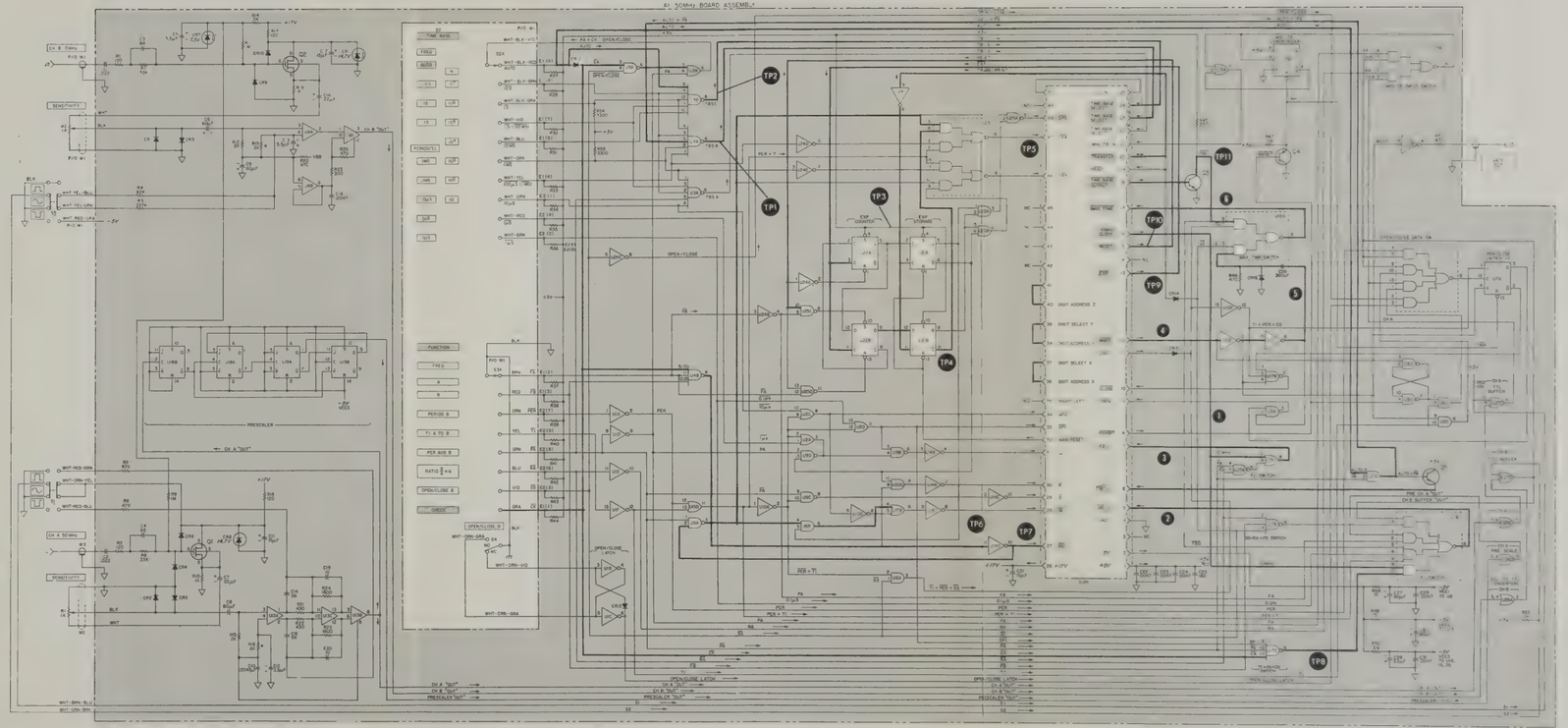


Figure 9B-5-9
SELF CHECK MODE TROUBLESHOOTING CHART
9B-5-29

Figure 9B-7-2
A1 5 MHz Board Assembly (Series 1112A or 1332A)
(See Page 9B-7-7)

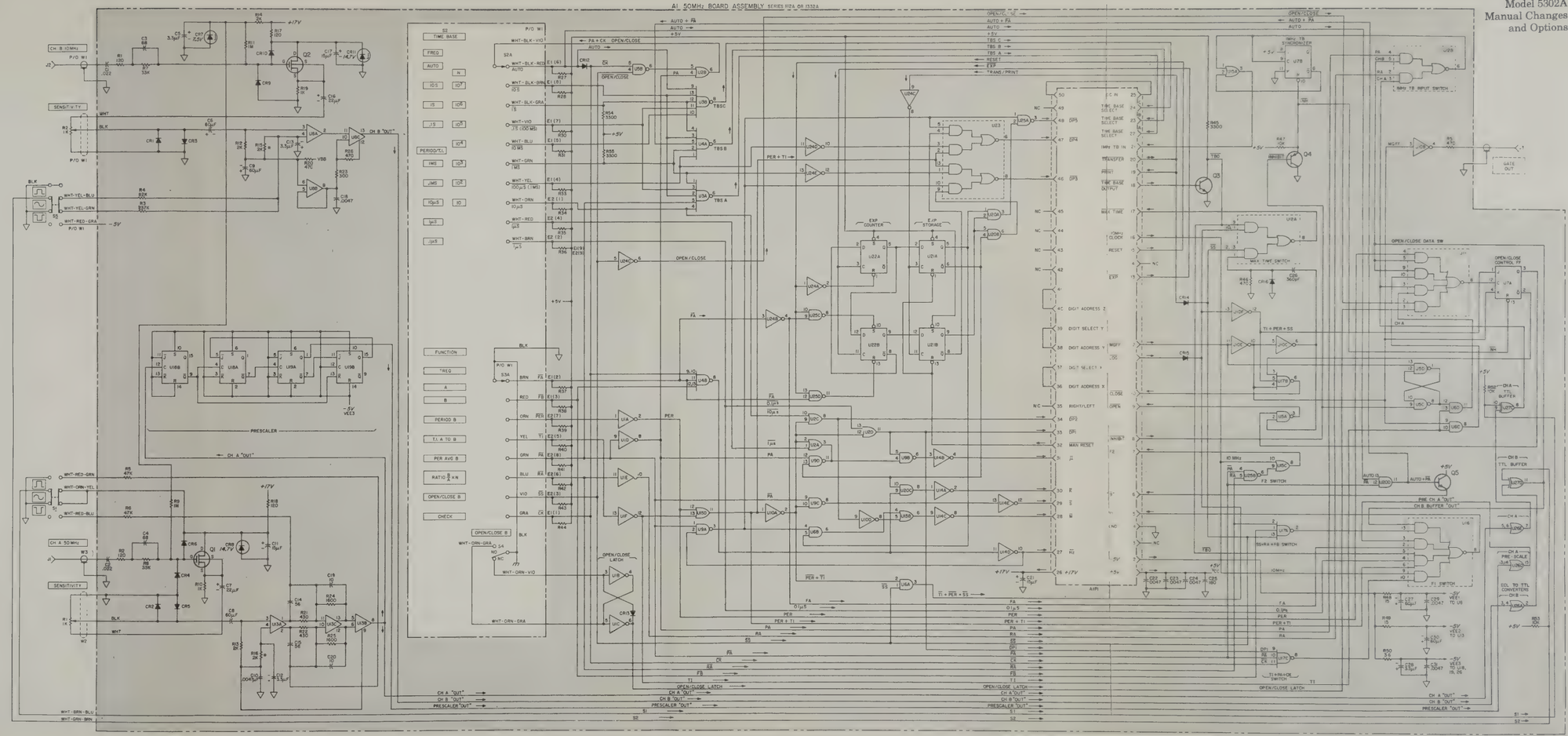


Figure 9B-7-2
A1 50 MHz Board Assembly (Series 1112A or 1332A)
9B-7-7

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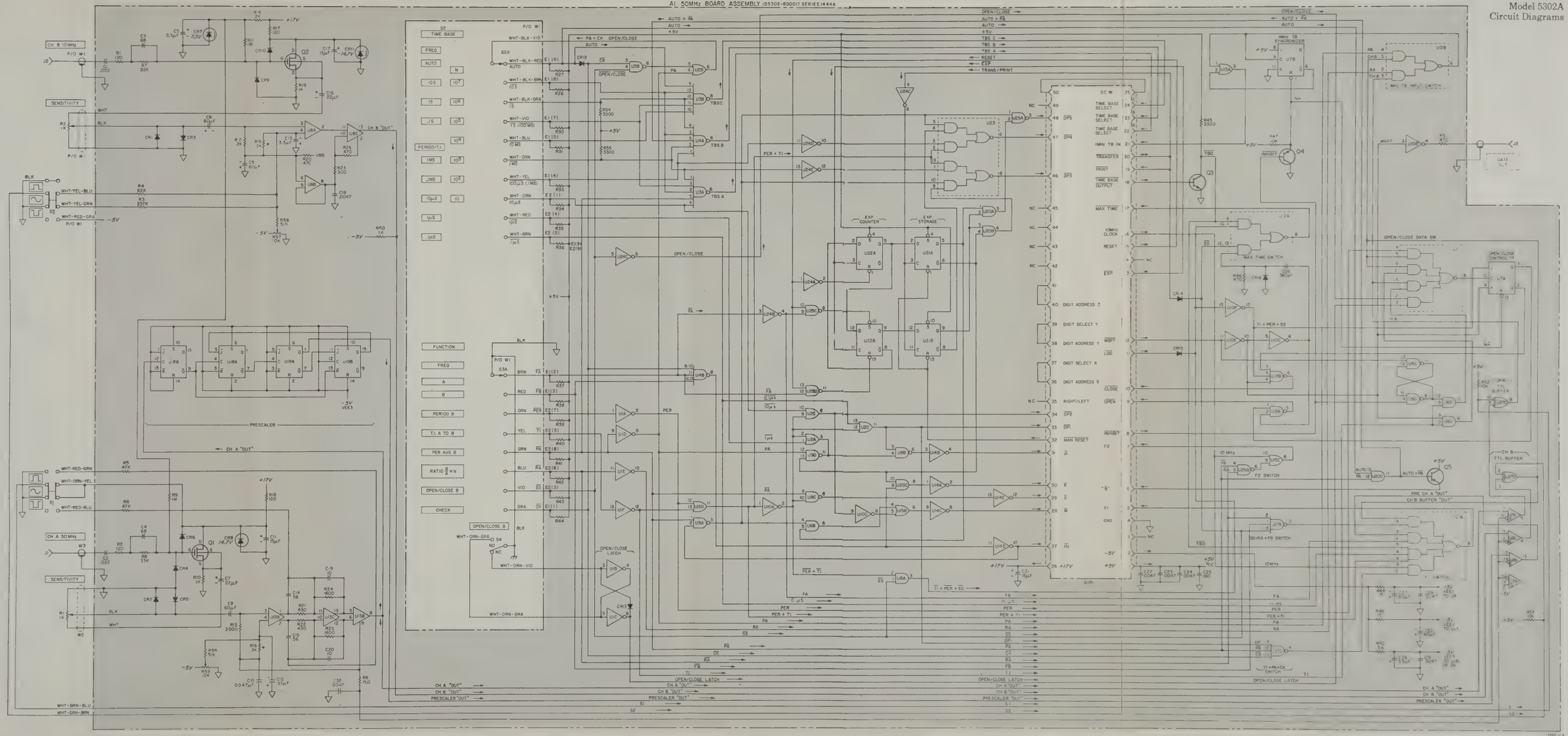


Figure 9B-8-1
A1 50 MHz Board Assembly
9B-8-7

Figure 9B-8-1
A1 50 MHz Board Assembly

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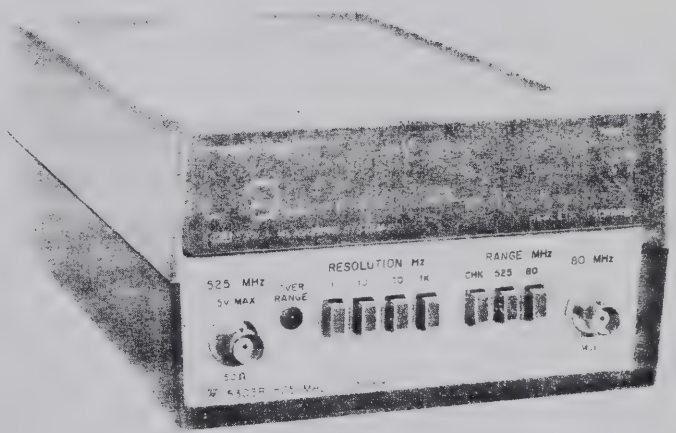
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OPERATING AND SERVICE MANUAL

525 MHz COUNTER

5303B



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The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

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HP MODEL 5303B 525 MHz COUNTER

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SECTION IX C

525 MHz COUNTER

5303B

OPERATING AND SERVICE MANUAL

SERIAL PREFIX: 1240A

This Section applies directly to HP Model 5303B 525 MHz Counters having Serial Prefix 1240A. The section is provided in loose-leaf form for incorportion into the 5300A Measurement System Manual.

NEWER INSTRUMENTS

This Section with enclosed "Manual Changes" sheet applies directly to HP Model 5303B 525 MHz Counters having Serial Prefix numbers above 1240A.

OLDER INSTRUMENTS

Subsection VII of this document contains information pertinent to all older instruments.

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SECTION IX C

5303B 525 MHz COUNTER

SUBSECTION I
GENERAL INFORMATION

9C-1-1. INTRODUCTION

9C-1-2. Description

9C-1-3. The Hewlett-Packard Model 5303B 525 MHz Counter, when plugged onto an HP Model 5300A Measuring System, is capable of measuring frequencies up to 525 MHz. The electrical and mechanical specifications are listed in Table 9C-1-1.

9C-1-4. Purpose and Use of Section IX C

9C-1-5. Section IX C contains the documentation necessary to operate, maintain, and repair the HP Model 5303B 525 MHz Counter plug-on. Also included are parts lists, component locators, and schematics. This information is intended to be inserted into the 5300A Measuring System manual as part of Section IX of that manual.

9C-1-6. INSTRUMENT IDENTIFICATION

9C-1-7. Hewlett-Packard uses a two-section, nine-digit serial number (0000A00000) mounted on the rear panel to identify the instrument. The first four digits are the serial prefix and the last five digits refer to the specific instrument. If the serial prefix on your instrument differs from that listed on the title page of this section, there are differences between the manual and your instrument. Lower serial prefixes are documented in Subsection VII and higher serial prefixes are covered by a manual change sheet included with the manual.

9C-1-8. The printed circuit board within the instrument is identified by a two-section, 10-digit part number (e.g., 05303-60007) and a four-digit series number (e.g., "SERIES 1240A"). The series number identifies the electrical characteristics of the complete printed-circuit assembly. A replacement circuit-board assembly may have a different series number than the assembly originally supplied with the instrument. Therefore, when troubleshooting a circuit-board assembly, ensure that the series number on the schematic diagram matches the series number on the board assembly. If the series number on the assembly is lower than the number on the schematic diagram in Subsection VIII, refer to Subsection VII of this document for change information. If the series number on the assembly is higher than the number on the schematic diagram in Subsection VIII, the change information is provided in a manual change sheet which is available from the nearest Hewlett-Packard Sales and Service Office.

9C-1-9. SPECIFICATIONS

9C-1-10. Table 9C-1-1 lists all specifications for the 525 MHz Counter.

Figure 9C-1-1. Model 5303B 525 MHz Counter

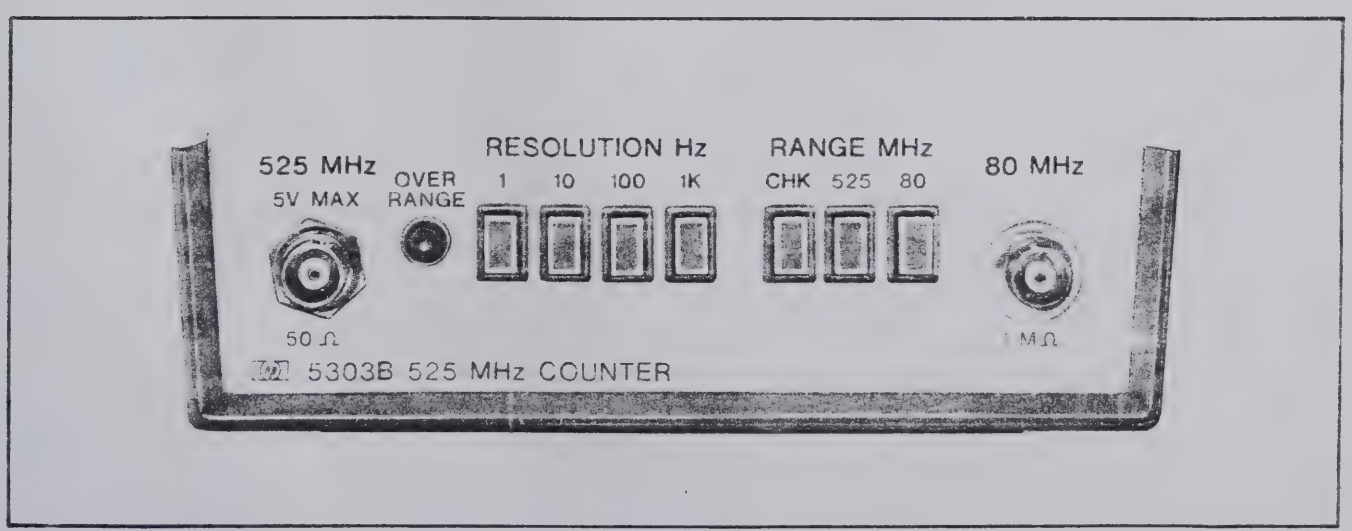


Table 9C-1-1. 5303B Specifications

525 MHz CHANNEL

Range: DC to 525 MHz, prescaled by 8.

Sensitivity (max): 100 mV rms sine wave, dc to 500 MHz, 500 to 525 MHz at 125 mV, dc coupled. Signal must pass through zero.

Impedance: 50Ω nominal.

Overload Protection: 5 V rms (input circuits fuse protected).

80 MHz CHANNEL

Range: 50 Hz to 80 MHz.

Sensitivity (max): 100 Hz to 50 MHz, 25 mV sine wave.
50 Hz to 100 Hz and 50 MHz to 80 MHz., 50 mV rms sine wave.

Impedance: 1 MΩ shunted by less than 40 pF.

Overload Protection: 250 V rms 50 Hz-10 kHz declining to 10 V rms above 10 MHz.

AGC Amplifier: Adjusts sensitivity automatically to compensate for input level variation, effective up to input clipping level of 10 V peak-to-peak.

FREQUENCY MEASUREMENT

Resolution: 1, 10, 100, 1000 Hz.

Gate Times: 1, .1, .01, .001 sec on 80 MHz range; 8, .8, .08, .008 sec on 525 MHz range.

Accuracy: ±1 digit ± time base accuracy.

Display: Hz, kHz, MHz with positioned decimal point.

HIGH STABILITY TIME BASE (OPTION 001)

Temperature compensated crystal oscillator in plug-on replaces function of 5300A mainframe oscillator.

Frequency: 10 MHz.

Stability: Aging rate: <1.2 parts in 10^6/yr.
Temperature: <±5 parts in 10^7. 0-50°C.
Line Voltage: <±5 parts in 10^8 for 10% line variation.

Oscillator Input Switch: Switch selects internal osc output or external osc input.

Oscillator Output: 10 MHz, approximately 1 V rms at rear panel BNC, 200Ω source impedance.

External Input: 1 MHz to 10 MHz, 1 V rms into 500Ω.

GENERAL

Check: Counts internal 10 MHz reference frequency.

Overflow: Light on front panel indicates when display is exceeded.

Operating Temperature: 0° to 50°C.

Power Requirements:
AC Operation: 115 or 230 V ±10%, 50 to 400 Hz through 5300A mainframe (nominally 10 watts including 5300A).
DC Operation: Rear panel banana jack input for external dc power source. 11-24 Vdc at 1A max. Fuse and diode protected.
Battery Operation: See 5310A Battery Pack Specifications.

Weight: Net, 2 lb (9,0 kg). Shipping, 3¼ lb (1,5 kg).

SECTION IX C

5303B 525 MHz COUNTER

SUBSECTION II
INSTALLATION

9C-2-1. UNPACKING AND INSPECTION

9C-2-2. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instruments for damage, such as scratches, dents, broken knobs, etc. If the instrument is damaged or fails to meet performance tests when used with the 5300A Measuring System, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately. Performance check procedures are located in Section IX C-5, and Sales and Service Offices are listed in Section VI of the 5300A portion of the manual. Retain the shipping carton and the padding material for the carrier's inspection. The Sales and Service Office will arrange for the repair or replacement of the instrument without waiting for the claim against the carrier to be settled.

9C-2-3. STORAGE AND SHIPMENT

9C-2-4. PACKAGING. To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your Hewlett-Packard Sales and Service office can provide packaging material, such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here is one recommended packaging method:

a. The original container is a corrugated cardboard box with 200 lbs. burst test (HP No. 9211-1620). The instrument is secured and protected, while in the box, by a top and bottom molded frame of polystyrene foam (HP No. 9220-1545). Also included with the instrument is a plastic dust-protection cover HP Part No. 9220-1762.

9C-2-5. ENVIRONMENT. Conditions during storage and shipment should be normally limited as follows:

a. Maximum altitude: 25,000 ft.
b. Minimum temperature: -40°F (-40°C).
c. Maximum temperature: +167°F (+75°C).

9C-2-6. INSTALLATION AND REMOVAL OF PLUG-ON

9C-2-7. The 5303B 525 MHz Counter must be used with a mating 5300A Measuring System, before any measurements can be made. To mate the 5303B 525 MHz Counter with the 5300A Measuring System, see Figure 2-1 and Paragraph 2-11 in the 5300A portion of the manual.

9C-2-8. PORTABLE OPERATION

9C-2-9. The use of the HP Model 5310A Battery Pack enables the 5300A Measuring System and 5303B 525 MHz Counter to be used in areas removed from ac power sources. The 5310A Battery Pack typically provides 5 hours of portable operating time before recharging. Table 1-2 and 1-4 in 5300A portion of the manual lists the HP 5310A Battery pack as an available accessory. Documentation on the 5310A is also included in Section IV through VIII of the 5300A portion of the manual. To prepare the 5300A/5303B for portable operation, refer to Paragraph 2-15 and Figure 2-2 steps a to c in the 5300A portion of the manual.

SECTION IX C
5303B 525 MHz COUNTER

SUBSECTION III
OPERATION

9C-3-1. OPERATING INFORMATION

9C-3-2. The 5303B 525 MHz Counter performs frequency and ratio measurements. Two channels are provided to give a combination of high-frequency measurements and high-sensitivity, lower-frequency measurements. A Self-Check mode is also available and ensures the operator that the counter is functioning properly.

9C-3-3. Input Channels

9C-3-4. The 80 MHz input channel is direct counting from 50 Hz to 80 MHz. The channel is ac coupled with a maximum sensitivity of 25 mV rms sine wave from 100 Hz to 50 MHz and 50 mV rms from 50 to 100 Hz and 50 to 80 MHz. The 1 MΩ input impedance easily accommodates a 10 to 1 divider probe, which increases the input impedance to 10 MΩ and allows in-circuit testing.

9C-3-5. The 525 MHz input channel is dc coupled and prescales the input frequency by a factor of eight. This enables the plug-on to count frequencies from dc to 525 MHz. An internal fuse protects the circuits from overloads greater than 5 V rms. Although the open circuit caused by a blown fuse will prevent low-frequency measurements, it may not be effective in preventing high-frequency signals from reaching the input circuits and causing overload damage. Should the fuse blow, a replacement fuse is located on A1 Logic Board (refer to Subsection VIII).

9C-3-6. Resolution

9C-3-7. In a frequency counter, resolution can be defined as that frequency which appears in the display's least-significant digit (LSD). The 5303B has been designed so that the resolution of any measured frequency can be selected with the front-panel switches. For example, with an input of 123,456 Hz, pushing the 1 kHz button places the "3" in the LSD. Pushing the 10 Hz button places the "5" in this position. Resolution can be expressed in terms of the counter's gate time, as shown in Table 9C-3-1.. The difference in the 525 MHz channel is the result of prescaling by eight.

Table 9C-3-1. Resolution vs Gate Time

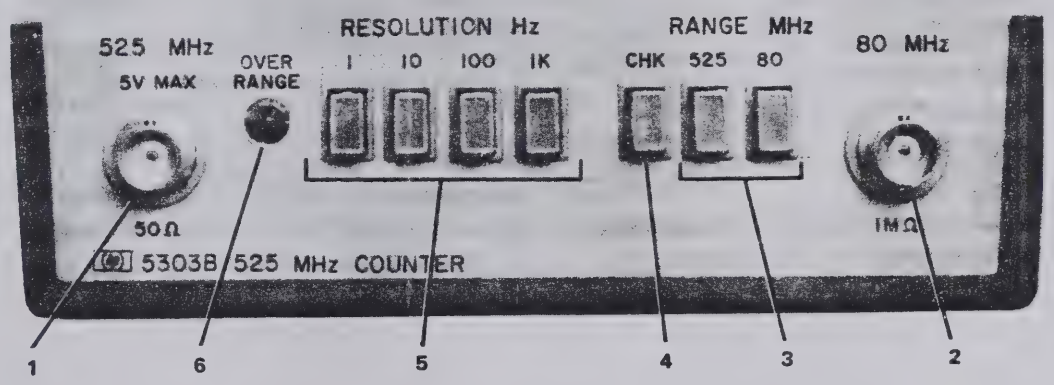
PUSHBUTTONS	RESOLUTION	GATE TIME	
		80 MHz	525 MHz
All Buttons Out	.1 Hz	10 s	80 s
1 Hz	1 Hz	1 s	8 s
10 Hz	10 Hz	.1 s	.8 s
100 Hz	100 Hz	.01 s	.08 s
1 kHz	1 kHz	1 ms	8 ms
1 Hz and 1 kHz*	10 kHz	.1 ms	.8 ms
10 Hz and 1 kHz*	100 kHz	10 μs	80 μs
100 Hz and 1 kHz*	1 MHz	1 μs	8 μs

*Ignore decimal points and annunciators

9C-3-8. Pushbutton Operation

9C-3-9. The front-panel pushbuttons are a mechanical-latch type. Pressing a pushbutton latches the switch and enables the indicated function. To release the pushbutton, depress another button in the same switch group (RESOLUTION or RANGE MHz). To release all pushbuttons under RESOLUTION (e.g.,), press gently on one unlatched button until the latched button releases. One exception is the CHK button, which, once latched, must be pushed again to be released. Two RESOLUTION pushbuttons may be engaged at the same time to provide additional resolution settings (see Table 9C-3-1).

Figure 9C-3-1. Front Panel Controls and Connectors



1. 525 MHz Input Jack. Measures Input frequencies from 0 to 500 MHz with input sensitivity of 100 mV rms sine wave and 125 mV from 500 to 525 MHz. Input impedance is 50 Ω nominal. Internal fuse protects circuitry from overloads greater than 5 V rms. Replacement fuse is stored on A1 Logic Board.

2. 80 MHz Input Jack. Measures input frequencies from 50 Hz to 80 MHz. Input sensitivity is 25 mV rms from 100 Hz to 50 MHz and 50 mV from 50 to 100 Hz and 50 to 80 MHz. Input impedance may be increased to 10 MΩ by using 10 to 1 divider probe.

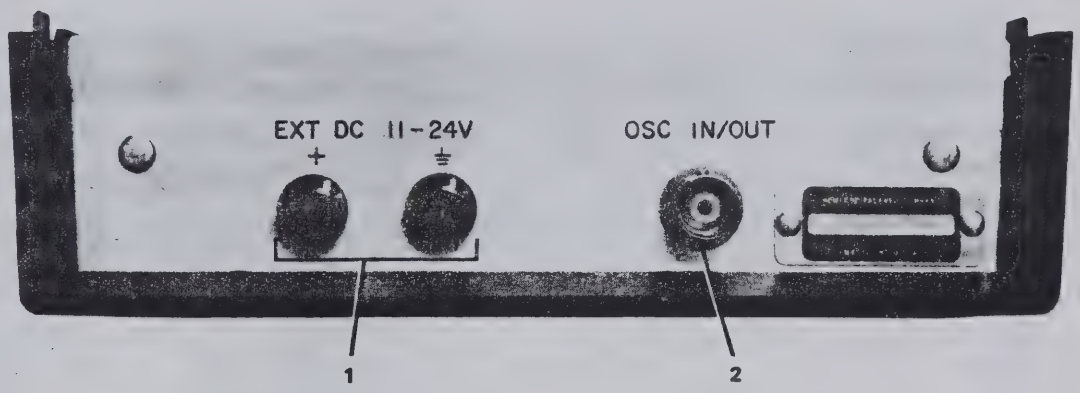
3. RANGE. Selects one of the two plug-on channels.
 a. 80 MHz: Enables plug-on to count signal applied to 80 MHz jack.
 b. 525 MHz: Enables plug-on to count the signal applied to 525 MHz jack.

4. CHK Switch. Allows system to count the internal 10 MHz clock signal. The measurement is not affected by signals connected to the input jacks.

5. RESOLUTION. The counter's least significant digit displays the measured resolution of the input signal that is selected with the switch. For example, 10 Hz selected; 6,789 Hz input frequency: counter displays 6.78 kHz.

6. OVER RANGE Lamp. Lights when accumulated count exceeds display capacity. If two digits of data have overflowed, the overflow lamp in the 5300 will also light.

Figure 9C-3-2. Rear Panel Connectors



1. EXT DC Jacks. Fused dc inputs for portable operation on external supply. Unit accepts 11–24 Vdc at 1A maximum.

 NOTE

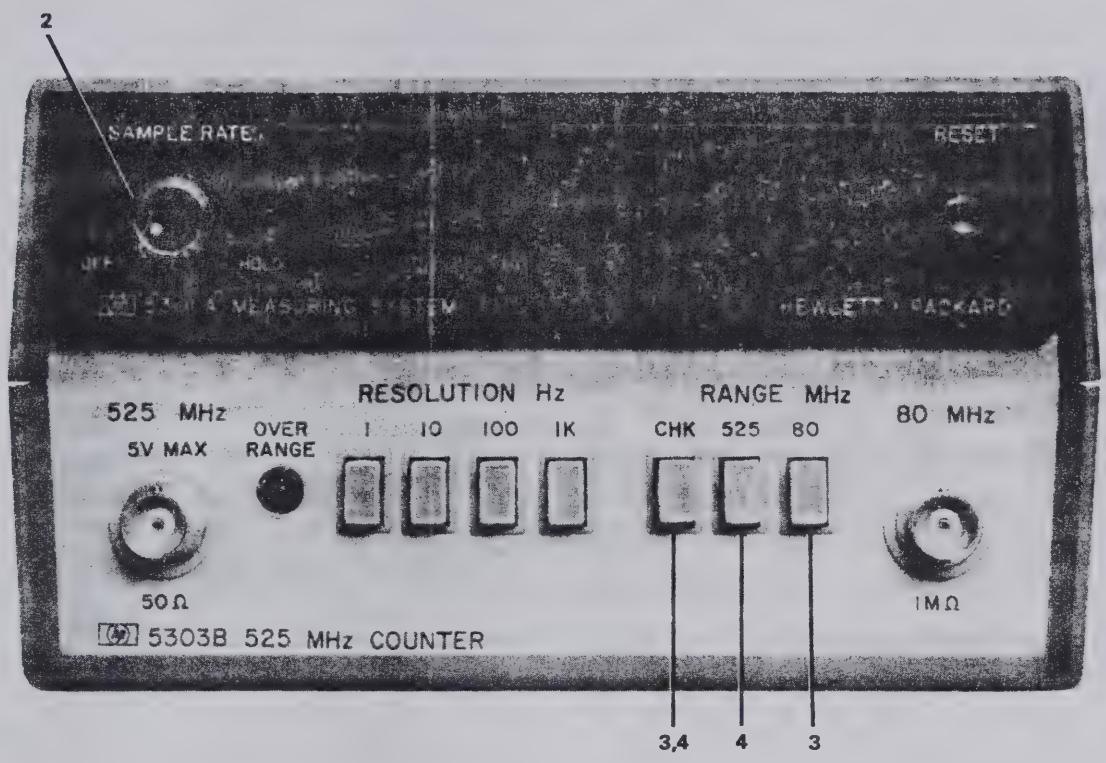
 Right-hand jack is chassis ground. Do not connect floating supply to this connection.

2. OSC IN/OUT Jack (Option 001 only). With OSC switch (located on A1 board) set to INT, jack provides 10 MHz clock output at 1 V rms openload, or 0.25 V rms into 50Ω. With switch to EXT, jack accepts substitute clock signal of 1 to 10 MHz at 1 V rms into 500Ω.

WARNING

TO AVOID POSSIBILITY OF BODILY INJURY AND/OR EQUIPMENT DAMAGE WHILE PERFORMING THE FOLLOWING PROCEDURE, BE SURE TO OBSERVE POLARITY REQUIREMENTS WHEN CONNECTING TEST LEADS. (HEWLETT-PACKARD RECOMMENDS USING AN ISOLATION TRANSFORMER WHEN MEASURING AC LINE FREQUENCIES.) ADDITIONALLY, DO NOT EXCEED THE INPUT VOLTAGE LIMITATIONS AS SPECIFIED IN TABLE 9C-1-1.

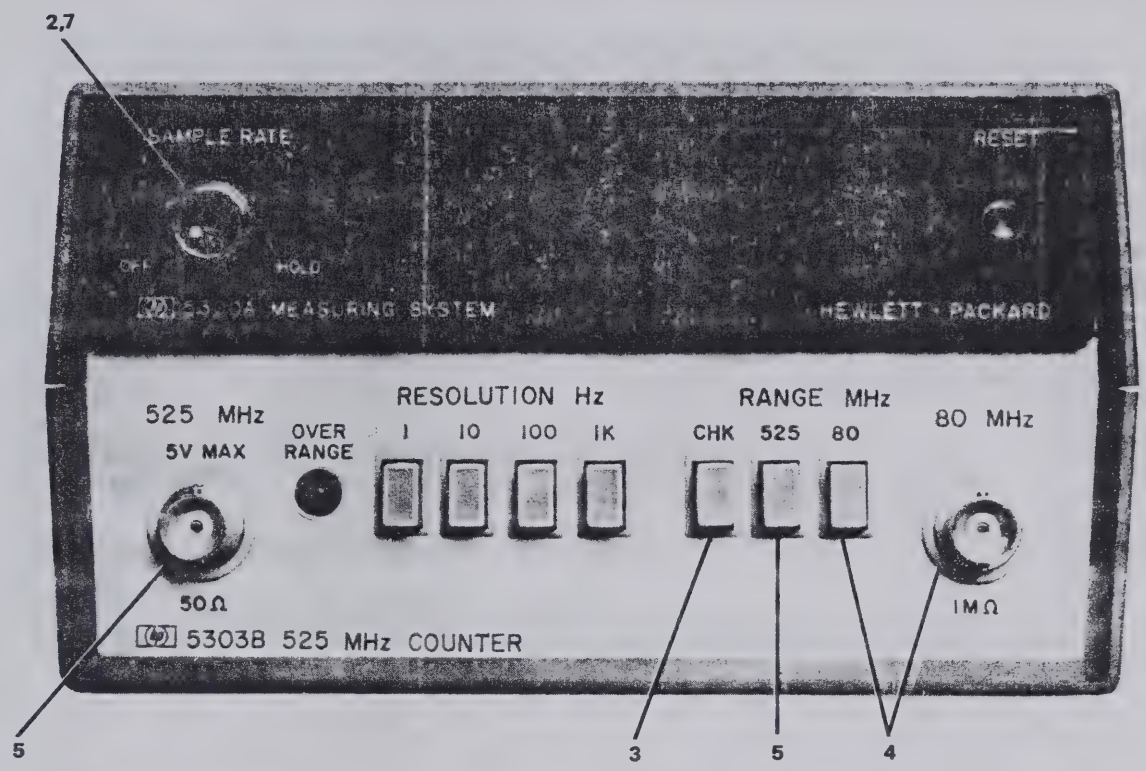
Figure 9C-3-3. Making Self-Check Measurements



1. Apply input power to 5300A ac receptacle.
2. Turn counter on with 5300A SAMPLE RATE control. Adjust SAMPLE RATE for minimum display time (full ccw).
3. Depress CHK and 80 MHz switches. Display is a function of RESOLUTION switch.
4. Depress CHK and 525 MHz switches. Results are same as step 3, except that operator must wait 8 seconds for 1 Hz resolution and 80 seconds for .1 Hz.

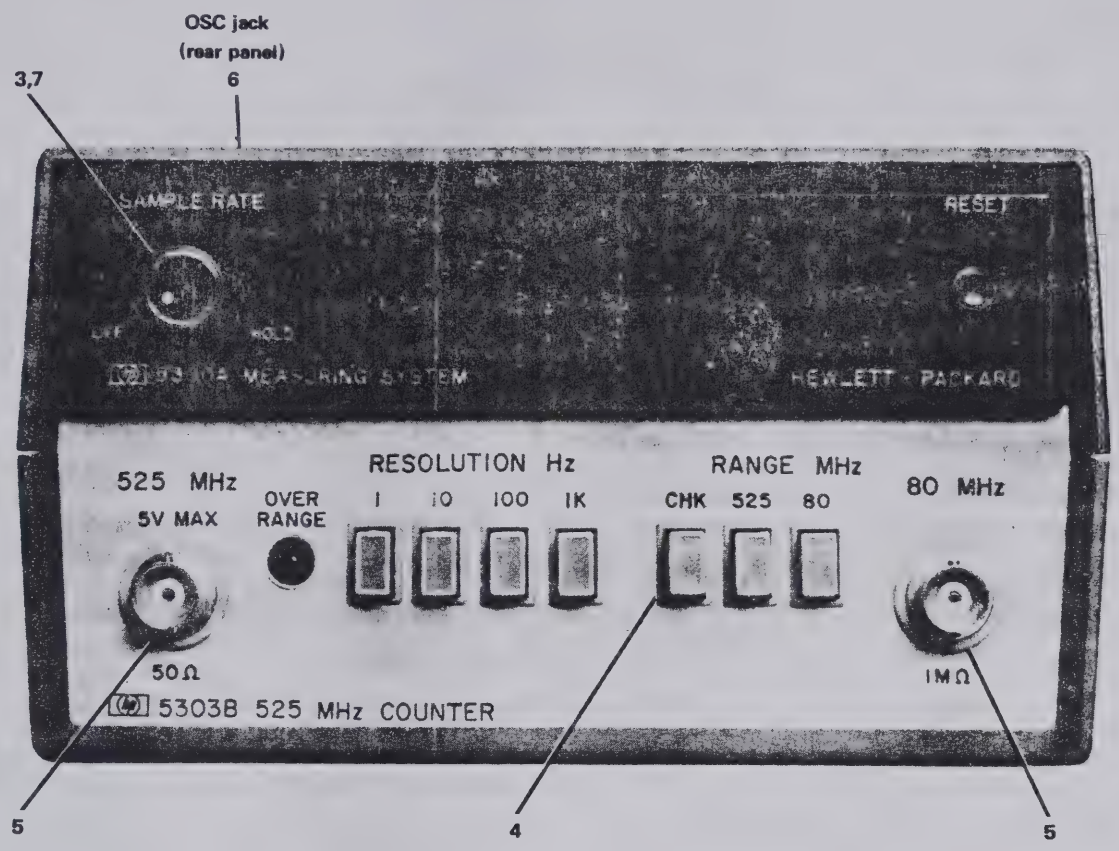
RESOLUTION	DISPLAY	ANNUNCIATOR
1 kHz	010.000 ±1 count	M, Hz, C
100 Hz	10000.0 ±1 count	K, Hz, C
10 Hz	0000.00 ±1 count	K, Hz, C, OR
1 Hz	000000 ±1 count	Hz, C, OR, and 5300A OF
.1 Hz (all buttons out)	00000.0 ±1 count	Hz, C, OR, and 5300A OF (must wait 10 S)

Figure 9C-3-4. Making Frequency Measurements



1. Apply input power to 5300A ac receptacle.
2. Turn counter on with 5300A SAMPLE RATE control.
3. If CHK switch is depressed, release switch by pushing it again.
4. To use 80 MHz channel, connect input signal to 80 MHz jack and push 80 MHz RANGE switch.
5. To use 525 MHz channel, connect input signal to 525 MHz jack and push 525 MHz RANGE switch.
6. Instrument's display is the input signal's frequency.
7. Adjust SAMPLE RATE for desired display time.

Figure 9C-3-5. Making Ratio Measurements



1. With ac power disconnected, remove plug-on from 5300A and set OSC INT/EXT switch to EXT. In standard instrument, switch is located in 5300A near power transformer. In 5303B with Option 001, switch is located on plug-on's A1 board; A1 board must be removed from case. Reconnect assemblies.
2. Apply input power to 5300A ac receptacle.
3. Turn counter on with 5300A SAMPLE RATE control.
4. If CHK switch is depressed, release switch by pushing it again.
5. Connect F_A input signal to desired channel and depress RANGE switch for that channel. Do not exceed 5 V rms into 525 MHz channel.
6. Connect F_{ext} (1 to 10 MHz) signal to rear panel OSC jack. This is 5300A OSC jack for standard instrument and plug-on's OSC jack for Option 001. Maximum input is 3 V rms. Recommended 1 V rms.
7. Adjust SAMPLE RATE control for desired display time.
8. $\text{Ratio} = \frac{F_A}{F_{ext}} = \frac{\text{Display}}{\text{Multiplier}}$

RESOLUTION	MULTIPLIER
.1 (all buttons out)	10^8
1	10^7
10	10^6
100	10^5
1 K	10^4

SECTION IX C
5303B 525 MHz COUNTER

SUBSECTION IV
THEORY OF OPERATION

9C-4-1. CIRCUIT OPERATION

9C-4-2. The 5303B uses two input channels for frequency measurements. The first is a 50Ω 525 MHz input, located on the A1 Logic Board, and the second is a 1 MΩ 80 MHz input, located on a separate amplifier board, A2. The following circuit theory includes the operation of the 525 MHz input.

9C-4-3. A1 Logic Board

9C-4-4. The signal feeds into the 50Ω input of J1. The input fuse F3 helps protect the input circuitry from excessive voltages. Input voltages greater than ±10.5 V turn on CR9 and CR10 and shunt the signal to ground through CR8 and CR11. E1 limits the input level to about ±1 V and provides protection up to 5 V rms. There is about 2 dB loss through E1. The signal passes to U1 amplifier/Schmitt trigger, which is biased for sensitivity by R5. The square wave from U1(11) is divided by four by U2 and U3. Q1 shifts the level from EECL (0 V to -0.7 V) to the middle of the ECL range (-.7 to -1.6 V). U4 divides the signal by two before Q2 shifts the level to +.8 to +1.7 V. The overall operation results in a divided-by-eight input frequency.

9C-4-5. This signal, along with the output of A2 amplifier, is sent to data switch U6. The front-panel RANGE switches determine which signal transfers to the output of U6. With the INHIBIT line high, the first negative-going pulse from U6(8) clocks the arming flip-flop, U10A, which enables the U13 clock decade. U12 selects the clock frequency for the input of U13. In the 80 MHz mode, the output of U12(6) is 10 MHz. In the 525 MHz mode, the clock frequency is 1.25 MHz, having been divided-by-eight in U15A, B and U14B. This division compensates for the previous divide-by-eight in the 525 MHz channel.

9C-4-6. The outputs of U13(8) and U10A(5) are sent to the mainframe, and the mainframe responds with a EXPONENT pulse, which toggles the main gate flip-flop U10B (pin 9 high, pin 12 low). This places a high on the inputs of main gate U11B and allows the high-speed decade (U7 and U8) to begin its counting process. The decade divides the signal by 10, which accommodates the 10 MHz counting limitation of the 5300A. While the main gate is open, the decade output is sent through U11C(8) for subsequent counting in the 5300A. At the end of the measurement, EXPONENT pulses low (U10B(12) is high) to close the main gate flip-flop. The TRANSFER line goes low, thereby shifting the decade data into the 4-bit latch U9. The latch stores this information until the end of the next measurement when another TRANSFER pulse enters new data. This information is displayed in the least significant digit of the LED display.

9C-4-7. DIGIT ADDRESS DECODING. Because of the need for a high-speed decade, the 5303B provides the least significant digit for the counting assembly. Therefore, the sixth decade in the mainframe counting assembly is not used. To accommodate having the least significant digit in the plug-on, rather than in the 5300A, a one must be subtracted from the Digit Select code. The codes of subsequent digits must also be subtracted by one to keep a proper relationship (see Table 9C-4-1).

9C-4-8. For example, when the digit address code is 0 (all low), U19D(11) and U20(5 and 9) place a code of 7 (all high) on the digit select lines. This allows data to be entered from the plug-on. At the same time, the high on U21B, C, and D enables the data gates of U18. Digit address "0" is the only time the outputs of U21B, C, D are high. Differentiator C15 and R17 produce a positive spike, which is inverted by U19C to set U20. At all other times, the changing state of DIGIT ADDRESS X clocks the 2-bit counter U20 to give the proper digit select code.

9C-4-9. OVERFLOW. Since the sixth decade of the mainframe counter is not used, the plug-on must supply its own overflow light. The "9" line from the mainframe counter goes low at a count of 90K and high at 100K. The positive edge clocks U14A after being buffered by CR2 and Q3. A TRANSFER pulse stores this overflow condition in U16, which turns Q5 on and lights the OVER RANGE indicator, CR1. U14A is reset at the end of the measurement by a RESET pulse. At the end of the next measurement, another TRANSFER pulse resets U16. The overflow storage will not reset if U14A has again been clocked during the measurement.

9C-4-10. TIME BASE, ANNUNCIATOR, and DECIMAL POINT DECODING. The selection of the time base and annunciator and the position of the decimal point is strictly a function of the front-panel switches and not of any accumulation of pulse count. The only active element is U19A, which alters the decimal point code from the front-panel switches. Refer to Table 9C-4-2 for proper coding of switch positions.

Table 9C-4-1. Digit Select Codes

CODE	DIGIT ADDRESS LINES*			CODE	DIGIT SELECT LINES*		
	Z	Y	X		Z	Y	X
0	L	L	L	7	H	H	H
1	L	L	H	0	L	L	L
2	L	H	L	1	L	L	H
3	L	H	H	2	L	H	L
4	H	L	L	3	L	H	H
5	H	L	H	4	H	L	L

*X = 1, Y = 2, Z = 4

9C-4-11. 10 MHz OSCILLATOR. In the standard instrument, the mainframe provides the plug-on with the clock signal. The signal feeds through R15 to the clock switch U12 and clock divider U14B and U15.

9C-4-12. The optional high-stability oscillator is located on A1 Logic board. The oscillator unit, Y1, is a temperature-controlled crystal oscillator (TCXO), whose output signal is buffered by U5. With the INT/EXT switch placed to INT, U5F inverts the oscillator signal and presents it to the OSC IN/OUT jack, J5. C1 removes any dc component from the signal. The oscillator's output level is 1 volt rms. Placing the switch to EXT disconnects the TCXO and allows the substitution of an external standard for the clock signal.

9C-4-13. When the option is installed, R15 is physically removed from its position on the board and becomes R11. This opens the circuit to the CLOCK output A1P1(16).

9C-4-14. CHECK MODE. When the front-panel CHK pushbutton is depressed, the plug-on performs a self-check operation by substituting the internal 10 MHz clock signal for an input signal. With the 80 MHz pushbutton depressed, the clock signal passes through an enabled U12 to U6(9). The CHK switch places a high on U6(10). This allows the signal to pass through U6 and the high-speed decade, U7 and U8. The output gate U11C transfers the signal to the F1 line for subsequent counting in the mainframe. The 525 MHz operation is the same, except U15A and B and U14A divide the clock signal by eight before passing it through U12.

Table 9C-4-2. Time Base Codes

RESOLUTION	GATE TIME		TBC	TBB	TBA
	80 MHz	525 MHz			
1 Hz	1 s	8 s	H	H	L
10 Hz	.1 s	.8 s	H	L	H
100 Hz	.01 s	.08 s	H	L	L
1 kHz	1 ms	8 ms	L	H	H
All Buttons out	10 s	80 ms	H	H	H

9C-4-15. A2 AGC Amplifier/Schmitt Trigger

9C-4-16. The A2 AGC Amplifier/Schmitt trigger assembly provides the 5303B with a direct-counting capability to 80 MHz. The AGC (automatic gain control) circuit accepts varying input levels and furnishes the Schmitt trigger with a constant input level. The output of the trigger circuit is a square wave at about three volts peak-to-peak in amplitude.

9C-4-17. The signal enters the amplifier through dc block capacitor C2, which, along with C3, R1, R2, CR1, and CR2, protects against large ac peaks at low frequencies. At high frequencies, R2 and the limiting diodes CR1 and CR2 provide the input protection for the unity gain bootstrapped source follower circuit Q1 and Q2.

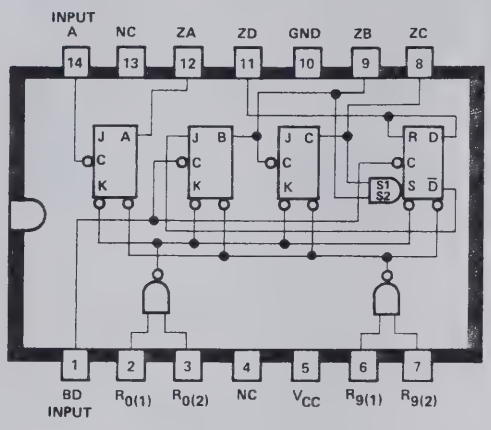
9C-4-18. U1 amplifies the coupled signal and feeds it to the rectifier network CR5, CR6, and filter capacitor C15. The dc level at U2(3) is, therefore, a function of U1 output. The higher the dc level, the more current U2 passes through attenuator diodes CR3 and CR4. The increased current reduces the impedance of the diodes and shunts more of the input signal to ground, thereby keeping the output at U1(7) constant. The Schmitt trigger, consisting of Q3 through Q6, shapes the signal into a square wave before passing it through emitter follower Q7 to the data switch, A1U6.

9C-4-19. INTEGRATED CIRCUITS

9C-4-20. Integrated circuit diagrams, with truth tables where necessary, are provided in Figure 9C-4-1. Use this information when detailed information about a specific integrated circuit is required.

Figure 9C-4-1. Integrated Circuit Diagrams

1820-0055 (SN7490N)
DECADE COUNTER



TRUTH TABLES

BCD COUNT SEQUENCE
(SEE NOTE 1)

COUNT	OUTPUT			
	Z_A	Z_B	Z_C	Z_D
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H

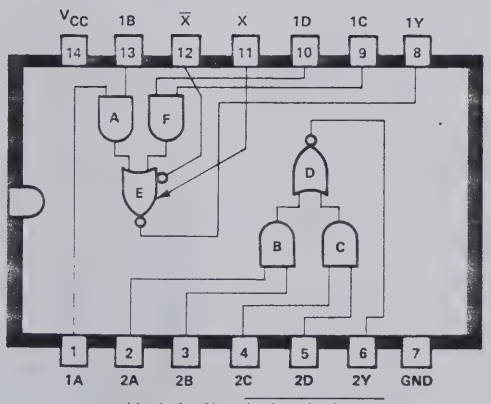
RESET/COUNT
(SEE NOTE 2)

RESET INPUTS				OUTPUT
$R_{0(1)}$	$R_{0(2)}$	$R_{9(1)}$	$R_{9(2)}$	D C B A
1	1	0	X	0 0 0 0
1	1	X	0	0 0 0 0
X	X	1	1	1 0 0 1
X	0	X	0	COUNT
0	X	0	X	COUNT
0	X	X	0	COUNT
X	0	0	X	COUNT

NOTES

1. Output A connected to input BD for BCD count.
2. X indicates that either a logical 1 or a logical 0 may be present.

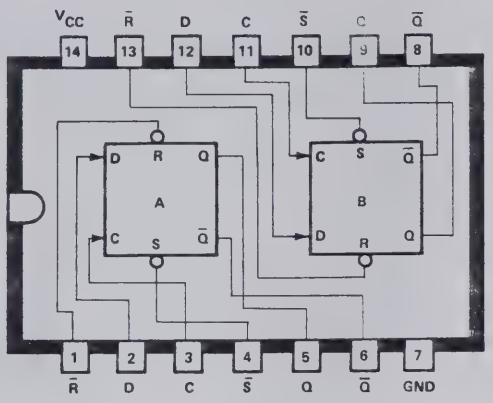
1820-0072 (SN7450N)
DUAL 2-WIDE 2-INPUT AND-OR-INVERT GATES



positive logic: $Y = \overline{(AB) + (CD) + X}$

Figure 9C-4-1. Integrated Circuit Diagrams (Continued)

1820-0077 (SN7474N)
DUAL D-TYPE EDGE-TRIGGERED FLIP-FLOP
POSITIVE LOGIC

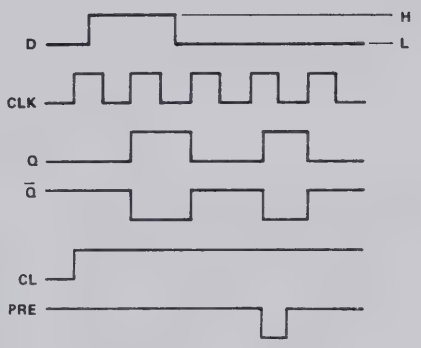


TRUTH TABLE
(EACH FLIP-FLOP)

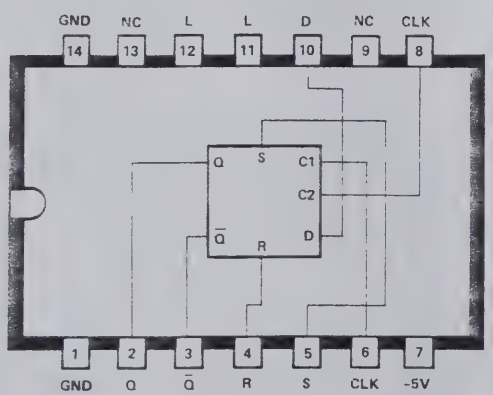
t_n	t_{n+1}	
INPUT D	OUTPUT Q	OUTPUT $\bar{Q}$
0	0	1
1	1	0

NOTES

1. t_n = BIT TIME BEFORE CLOCK PULSE
2. t_{n+1} = BIT TIME AFTER CLOCK PULSE
3. POSITIVE LOGIC:
 - A. LOW INPUT TO CLEAR SETS Q TO LOGICAL 0
 - B. LOW INPUT TO PRESET SETS Q TO LOGICAL 1
 - C. CLEAR OR PRESET INPUTS DOMINATE REGARDLESS OF CLOCK AND D INPUTS



1820-0101 (MC1034)
D-TYPE FLIP-FLOP



R-S TRUTH TABLE

R	S	Q^{n+1}	$\bar{Q}^{n+1}$
4	5	2	3
0	0	Q^n	$\bar{Q}^n$
0	1	1	0
1	0	0	1
1	1	ND	ND

ND = NOT DEFINED

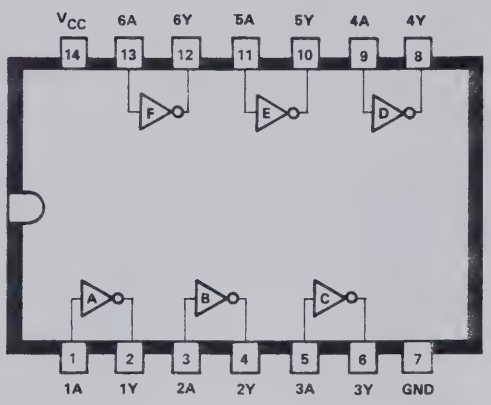
CLOCKED TRUTH TABLE

D	C	Q^{n+1}	$\bar{Q}^{n+1}$
10	6OR8	2	3
0	0	Q^n	$\bar{Q}^n$
1	0	Q^n	$\bar{Q}^n$
0	1*	0	1
1	1*	1	0

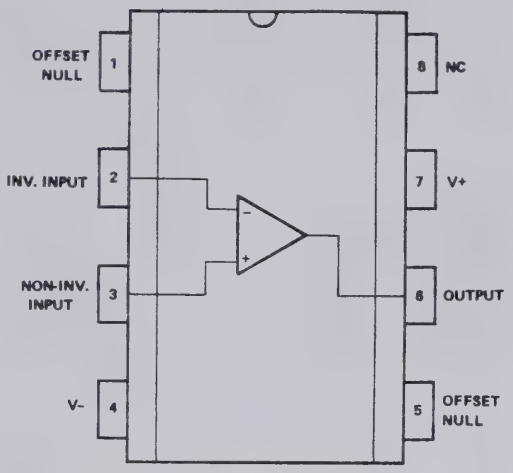
*A "1" OR CLOCK INPUT IS DEFINED FOR THIS FLIP-FLOP AS A CHANGE IN LEVEL FROM A LOW STATE TO A HIGH STATE OF THE CLOCK

Figure 9C-4-1. Integrated Circuit Diagrams (Continued)

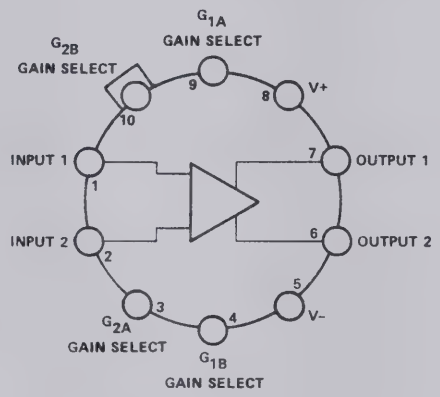
1820-0174 (SN7404)
HEX INVERTER



1820-0216
OPERATIONAL AMPLIFIER

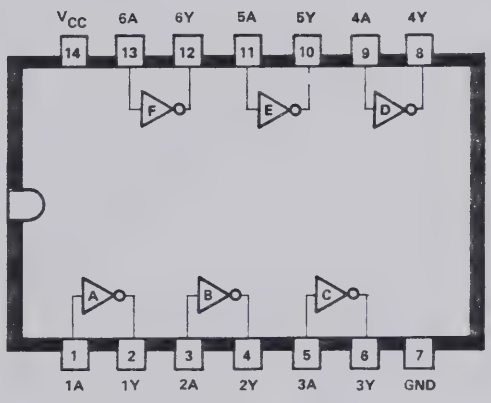


1820-0270
μA733 DIFFERENTIAL VIDEO AMPLIFIER

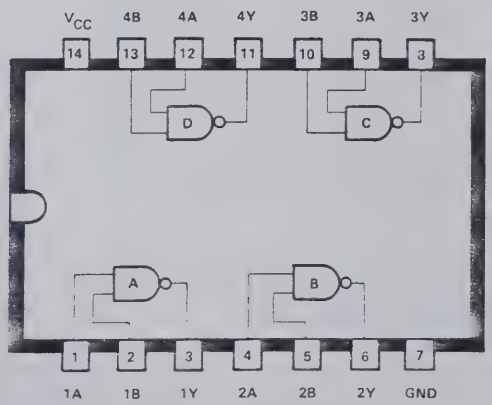


Note: Pin 5 connected to case.

1820-0307 (MC836F)
HEX INVERTER



1820-0583 (SN74L00)
QUADRUPLE 2-INPUT POSITIVE NAND GATES



1820-0585 (SN74L03)
QUADRUPLE 2-INPUT POSITIVE NAND GATES

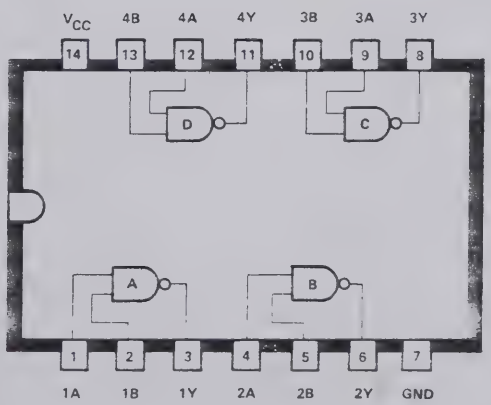
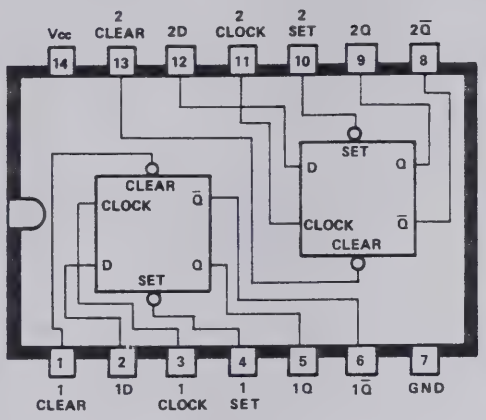


Figure 9C-4-1. Integrated Circuit Diagrams (Continued)

1820-0596 (SN74L74)
DUAL D-TYPE EDGE-TRIGGERED FLIP-FLOP



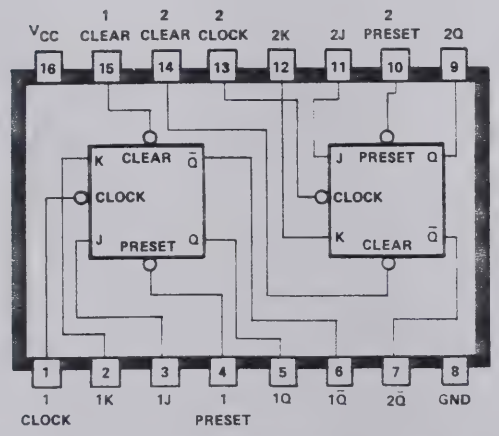
TRUTH TABLE
(EACH FLIP - FLOP)

t_n	$t_n + 1$	
INPUT	OUTPUTS	
D	Q	$\bar{Q}$
L	L	H
H	H	L

H = HIGH LEVEL,
L = LOW LEVEL

NOTES: A. t_n = bit time before clock pulse
B. $t_n + 1$ = bit time after clock pulse

1820-0629 (SN74S112)
DUAL J-K EDGE-TRIGGERED FLIP-FLOPS



TRUTH TABLE

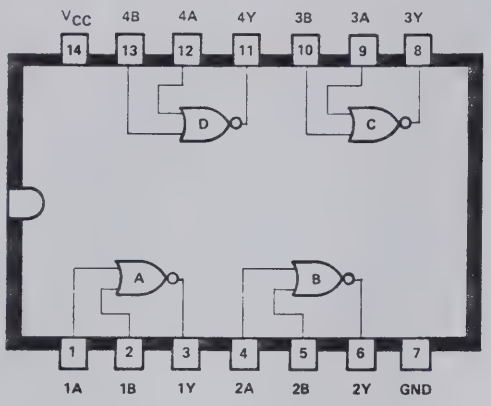
t_n		t_n+1
J	K	Q
L	L	Q_N
L	H	L
H	L	H
H	H	$\bar{Q}_N$

NOTES A. t_n = Bit time before clock pulse.
B. t_{n+1} = Bit time after clock pulse.

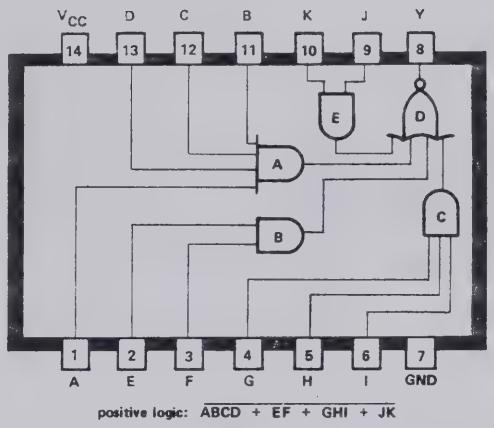
POSITIVE LOGIC: LOW INPUT TO PRESET SETS Q TO HIGH LEVEL.
LOW INPUT TO CLEAR RESETS Q TO LOW LEVEL.
CLEAR AND PRESET ARE INDEPENDENT OF CLOCK.

Figure 9C-4-1. Integrated Circuit Diagrams (Continued)

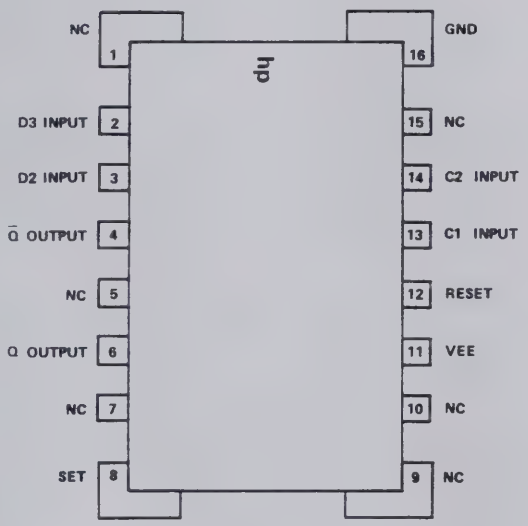
1820-0686 (SN74S11N)
QUAD 2-INPUT "NOR" GATE



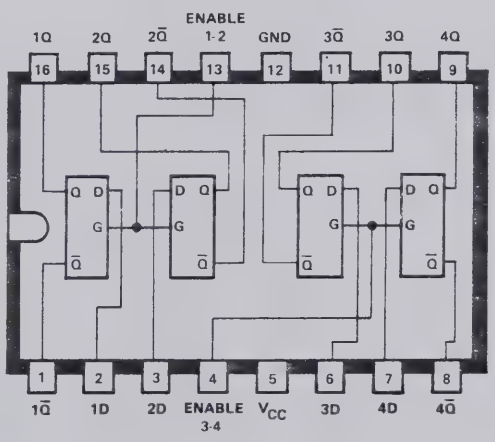
1820-0691 (SN74S64)
4-2-3-2-INPUT AND-OR-INVERT GATES



1820-0736
HIGH SPEED D-BINARY COUNTER



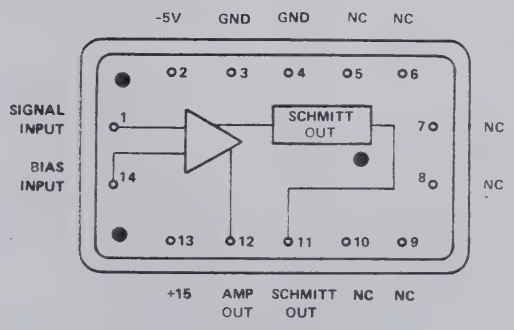
1820-0876 (SN74L75)
4 BIT BISTABLE LATCHES



TRUTH TABLE
(Each Latch)

INPUTS		OUTPUTS	
D	G	Q	Q̄
L	H	L	H
H	H	H	L
X	L	Q_0	$\bar{Q}_0$

5088-7001
TRIGGER AMPLIFIER



SECTION IX C
5303B 525 MHz COUNTER

SUBSECTION V
MAINTENANCE

9C-5-1. INTRODUCTION

9C-5-2. This subsection contains maintenance information for Model 5300A/5303B 525 MHz Counter. Performance checks, adjustment procedures, and tests to isolate defective components are included.

9C-5-3. RECOMMENDED TEST EQUIPMENT

9C-5-4. Test equipment recommended for performance checking and servicing the 5300A/5303B 525 MHz Counter is listed in Table 9C-5-1 and in Table 5-1 in the 5300A portion of the manual. Test equipment with equivalent characteristics may be substituted for listed equipment.

9C-5-5. IN-CABINET PERFORMANCE CHECK

9C-5-6. Use the performance check in Table 9C-5-2 and the test card at the back of this subsection to verify proper operation of all circuits in the counter and all circuits in the 5300 that are used with the counter plug-on. The performance check may be used:

a. As part of an incoming inspection check of instrumentation specifications.

b. Periodically, for instruments used in systems where maximum reliability is important.

c. As part of a procedure to locate defective circuits.

d. After any repairs or adjustments, before returning instrument to regular service.

9C-5-7. INSTRUMENT ACCESS

9C-5-8. For access to the plug-on assembly, separate the 5300 from the 5303B as follows:

a. Turn ac power OFF and disconnect power cord.

b. Pull the two side casting latches fully rearward (it is necessary to press the latch handles gently away from the center of the instrument to unlock them).

c. When latches are fully extended rearward, the 5300 and 5303B cast housings should be separated by about ⅛-inch.

d. Lift the 5300 gently away from the 5303B.

e. Separate 5303B Logic Board Assembly from the cast housing as follows (refer to Figure 9C-5-1):

1. Press rear, plastic-nylon retaining clips on each side of 5303B casting and lift the rear of the Logic Board Assembly to release it from the casting.

2. Press front plastic-nylon retaining clips on each side of 5303B casting and lift the front of the Logic Board Assembly to release it from the casting.

3. Lift Logic Board Assembly from the casting.

f. Mate the 5303B Logic Board Assembly to the 5300 and apply ac power.

g. To reinstall the Logic Board Assembly into the casting, reverse procedure of steps d through f.

9C-5-9. PERIODIC MAINTENANCE

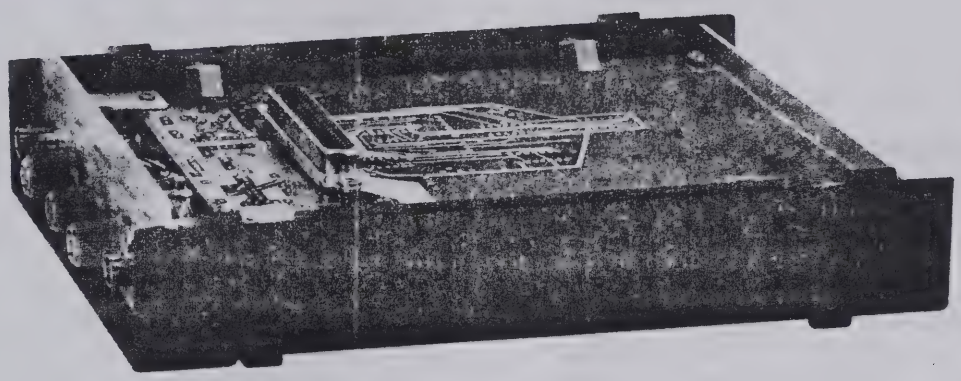
9C-5-10. To determine if the 5300A/5303B is operating properly, perform the In-Cabinet Performance Checks listed in Table 9C-5-2. These checks are also the 5300A performance checks when the 5300A/5303B combination is used.

9C-5-11. MAINTENANCE AND REPAIR

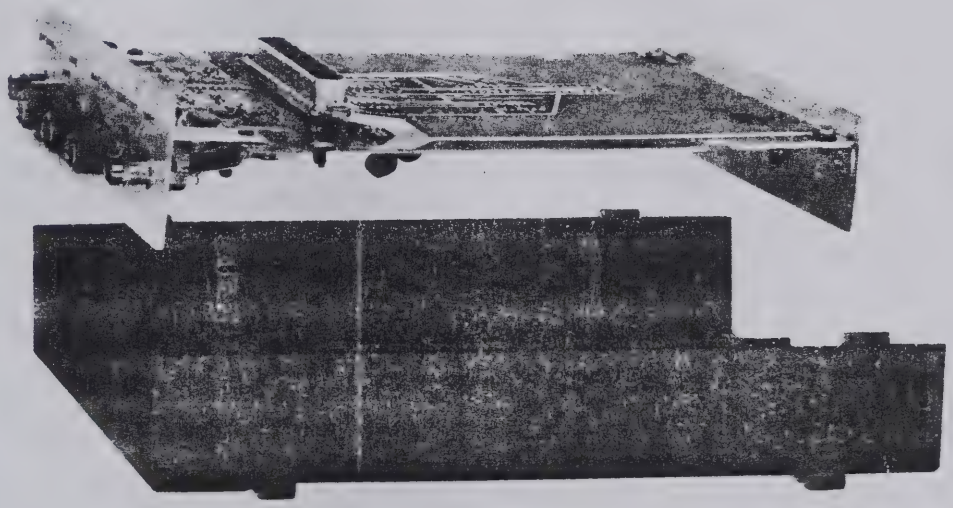
9C-5-12. BOARD REMOVAL. When removing the printed circuit board for replacement, repair, or servicing, always remove ac power and separate the board from the casting according to Paragraph 9C-5-7, steps a to e.

9C-5-13. COMPONENT REPLACEMENT. When replacing a circuit board component, use a low heat soldering iron. Heat must be used sparingly as damage to the circuit foil may result. Mounting holes may be cleaned out with a toothpick while heat is applied. Connection should be cleaned with a cleaning solution after component removal and replacement.

Figure 9C-5-1. Separation Procedure



STEP A



STEP B

9C-5-14. INTEGRATED CIRCUIT REPLACEMENT. Two methods are recommended for removing integrated circuits:

a. Solder Gobbler. Solder is removed from board by a soldering iron with a hollow tip connected to a vacuum source. The IC is removed intact, so it may be reinstalled if diagnosis is wrong.

b. Clip Out. This method is used when an IC is proven defective. Clip leads close to case, apply heat, and remove leads with long-nose pliers. Clean board holes with toothpick and cleaning solution.

9C-5-15. Before A1U1 is removed from its socket, the hex-nut on the back side of the board must be removed.

9C-5-16. ADJUSTMENTS

9C-5-17. The 5303B has two adjustments: a frequency adjustment for the optional TCXO and a sensitivity adjustment for the 525 MHz input. When adjusting the frequency of the optional TCXO, be sure that the temperature requirement of 25°C is accurately maintained. If the temperature deviates from 25°C, the specified accuracy limits of the oscillator may be exceeded. Additionally, changes in ambient temperature and the resulting frequency drift will cause aging rate measurements to be inaccurate.

9C-5-18. TCXO ADJUSTMENT. Adjust the high-stability time base, Option 001, as follows:

a. Remove bottom cover from 5303B.

b. Allow 1-hour for TCXO to stabilize.

c. Connect 5303B OSC jack (rear panel) to HP 5326C-011 Frequency Counter or equivalent.

d. Set 5326C-011 FUNCTION switch to FREQUENCY and TIME BASE switch to 10 S.

e. At 25°C ambient temperature for 5303B, 5326C-011 display should be the frequency that is printed on TCXO. For example: 10 000 003.3 Hz or 9 999 998.5 Hz.

f. Adjust the slot screw on the side of the TCXO metal can (approximately 1 part in 10^6 per turn) for the frequency that is printed on the TCXO.

9C-9-19. 525 MHz INPUT SENSITIVITY. Adjust the input sensitivity for the 525 MHz channel as follows:

a. On 5303B, depress 525 MHz RANGE switch and 1 kHz RESOLUTION switch.

b. Set HP 3200B UHF Oscillator and HP 13515A Frequency Doubler Probe for an output of 525 MHz at 500 mV. Measure the output with an HP 411A RF Millivoltmeter using a 50Ω termination at the probe.

c. Connect signal source to 525 MHz jack of counter.

d. Reduce oscillator's output until counter's display becomes unstable. Adjust A1R5 for a stable display. Repeat this procedure until unable to obtain a stable reading. Increase signal level until display becomes stable.

e. Disconnect input and connect to voltmeter. Reading should be less than 125 mV.

Table 9C-5-1. Recommended Test Equipment

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	RECOMMENDED INSTRUMENT
Electronic Counter	10 MHz frequency measurements and high-stability time base	HP 5326C-011
Oscilloscope	50 MHz Bandwidth	HP 180A/HP1801A/HP1820A
Test Oscillator	Range: 50 Hz to 10 MHz Output: 1 V rms into 50Ω	HP 651B
DC Voltmeter	Range: 10 V to 30 V, 1 mA to 1 A	HP 412A
Power Supply	Output: 10 to 30 V at 1 A	HP 6289A
RF Millivoltmeter	Frequency: 50 to 525 MHz Range: 25 mV to 300 mV	HP 411A
UHF Oscillator	Range: 80 to 525 MHz	HP3200B/HP13515A Frequency Doubler Probe
50-Ohm Feed-thru	50-Ohm male to female BNC	HP 11048A
Logic Probe	Indicate Logic Levels	HP 10525T

Table 9C-5-2. In-Cabinet Performance Check

1. OSCILLATOR

For standard plug-on, perform oscillator check as outlined in Paragraph 5-56 in the 5300A portion of the manual.

Option 001, High-Stability Time Base.

Obtain the following test equipment:

HP 5326C-011	Frequency Counter
HP 180A	Oscilloscope
HP 11048A	50-ohm feed-thru termination
HP 651B	Test Oscillator

a. Remove bottom cover from 5303B.

b. Allow 1-hour for TCXO to stabilize.

c. Connect 5303B OSC jack (rear panel) to 5326C-011 input jack.

d. Set 5326C-011 FUNCTION switch to FREQUENCY and TIME BASE switch to 10 S.

e. At 25°C ambient temperature for 5303B, 5326C-011 display should be the frequency that is printed on the TCXO. For example: 10 000 003.3 Hz or 9 999 998.5 Hz. Adjustment procedure is found in Paragraph 9C-5-18.

f. Disconnect 5303B OSC output from 5326C-011.

g. Connect 5303B OSC output to vertical input of 180A, using 50-ohm feed-thru at scope's input.

h. Oscillator waveform should appear as a square wave (50% duty cycle ±10%) with an amplitude of about 1 V p-p.

i. Disconnect 5303B oscillator from 180 scope.

j. On 5303B, depress CHK, 100 Hz RESOLUTION, and 80 MHz RANGE switches.

k. Set INT/EXT switch (located on A1 board) to EXT position.

l. Connect a 651B Test Oscillator to 5303B OSC jack, using a 50-ohm feed-thru at OSC jack. Set oscillator output to 1 V rms.

m. Vary the 651B frequency from 1 to 10 MHz.

n. Counter's display should be 10000.0 kHz. Count light (C) must be flashing.

o. Disconnect setup and place INT/EXT switch to INT.

p. For long-term stability check, operate the counter continually for at least 1 month. Measure frequency offset at 1-month intervals.

2. DISPLAY, DECIMAL POINTS, AND DIVIDERS

Proper operation is verified in the self-check procedure outlined in Figure 9C-3-3.

Table 9C-5-2. In-Cabinet Performanc Check (Continued)

3. EXTERNAL DC INPUT

Obtain the following test equipment:

HP 412A DC Voltmeter

HP 6289A Power Supply

a. Set 412A to current mode (MA) and RANGE switch to 3 mA.

b. Connect 412A to rear panel EXT jacks.

c. Leakage current should be <1 mA.

d. Disconnect 412A from EXT jacks.

e. Disconnect 115 Vac power line from counter.

f. On 6289A Power Supply, connect shorting bar between "GND" and "-" jacks.

g. Set power supply output to 20 V and connect to plug-on's EXT jacks. NOTE PROPER POLARITY.

h. On 5303B, depress CHK, 525 MHz RANGE, and 100 Hz RESOLUTION switches.

i. Vary output voltage of supply from 11 V to 24 V.

j. Counter should display 10000.0 kHz with count light (C) flashing.

k. Output current of supply should be <1 A.

l. Disconnect power supply and connect 115 Vac power cord.

4. FREQUENCY MODE

Obtain the following test equipment:

HP 411A RF Millivoltmeter

HP 651B Test Oscillator

HP 3200 B UHF Oscillator with HP 13515A Frequency Double Probe

HP 11048A 50-ohm feed-thru Termination

80 MHz Range

a. On 5303B, depress 80 MHz RANGE and 100 Hz RESOLUTION switches.

b. Connect 3200B Oscillator to 411A. Use 50-ohm termination with type N tee on 411A probe. Set oscillator to 80 MHz at 50 mV output.

c. Connect 3200B to 80 MHz jack of 5303B, using 50-ohm feed-thru at input.

d. Counter's display should be 80 000.0 kHz. Count light (C) must be flashing.

e. Check counter at 50 MHz with input level of 25 mV.

f. Counter should display 50000.0 kHz. Count light (C) must be flashing.

Table 9C-5-2. In-Cabinet Performance Check (Continued)

g. Disconnect 5303B from 3200B.

h. Connect 50Ω output of 651B oscillator to 80 MHz jack of 5303B, using 50-ohm feed-thru at input.

i. Set 651B to 50 Hz at 50 mV.

j. On 5303B, depress 1 Hz RESOLUTION switch. Counter should display 000050 Hz. Count light (C) must be flashing.

k. Disconnect 5303B from 651B.

525 MHz Range

a. On 5303B, depress 525 MHz RANGE and 1 kHz RESOLUTION switches.

b. Set dial of 3200B to read 500 MHz.

c. Connect output of 3200B to 411A. Use 50-ohm termination with type N tee on 411A probe.

d. Set level to 100 mV.

e. Connect output of 3200B to 525 MHz jack of 5303B.

f. Counter's display should be 500.000 MHz. Count light (C) must be flashing.

g. Disconnect 5303B from 3200B.

h. Connect HP 13515A Frequency Doubler Probe to output of 3200B.

i. Set dial of 3200B to read 263 MHz.

j. Connect output of doubler probe to 411A. Use 50-ohm Termination with type N tee on 411A probe.

k. Set level to 125 mV.

l. Connect output of doubler probe to 525 MHz jack of 5303B.

m. Counter's display should be 525.000 MHz. Count light (C) must be flashing.

n. Disconnect 5303B from 3200B and doubler.

o. Connect 50-ohm output of 651B to 525 MHz jack of 5303B.

p. Set 651B output to 100 Hz at 100 mV.

q. Depress 10 Hz RESOLUTION switch on 5303B.

r. Counter's display should be 0000.10 kHz. Count light (C) must be flashing.

9C-5-20. TROUBLESHOOTING

9C-5-21. Use the following troubleshooting information and the waveforms and schematic diagram in Subsection VIII to isolate troubles in the counter to a defective component.

9C-5-22. If a malfunction is suspected, operate the counter in the self-check mode (see Figure 9C-3-3) and analyze the front-panel indicators for evidence of improper operation. Some troubles can be quickly isolated in this manner. A self-check exercises most of the counter circuits; the input circuits for both channels are notable exceptions.

9C-5-23. Determine if a problem exists in both input channels or just one channel, then perform the appropriate troubleshooting procedure. Be sure to perform each step in sequence. The following test equipment is required:

a. HP 10525T Logic Probe,

b. HP 180A/1801A/1820A Oscilloscope,

c. HP 651B Test Oscillator.

9C-5-24. 525 MHz Channel Troubleshooting

9C-5-25. Press the 1K RESOLUTION switch, the 525 MHz RANGE switch, and supply a 9 kHz, 1-volt sinusoidal input from the test oscillator. Perform the following steps.

a. Check output of prescaler at U6(13) with the oscilloscope (see photograph of waveform).

b. If proper signal is not present, compare prescaler voltages and waveforms with those provided in Subsection VIII of this manual. Be sure to first check input fuse F3.

c. If proper signal is present, check operation of U6, U12, U14B, and U15.

9C-5-26. 80 MHz Channel Troubleshooting

9C-5-27. Press the 1K RESOLUTION switch, the 80 MHz RANGE switch, and supply a 9 kHz, 1-volt sinusoidal input from the test oscillator. Perform the following steps.

a. Check output of A2 amplifier at U6(4) (see photograph of waveform).

b. If proper signal is not present, compare voltages with those provided in Subsection VIII of this manual.

c. If proper signal is present, check operation of U6 and U12.

9C-5-28. Both Channels Inoperative Troubleshooting

9C-5-29. Press the 10 Hz RESOLUTION switch, the 80 MHz RANGE switch, and apply a 1.25 MHz sinusoidal input to the 80 MHz channel from the test oscillator. Perform the following steps.

a. If any display digit is blanked, proceed to "Address Decoder Troubleshooting."

b. If only the least significant digit is displayed, and all other are zero, check U11C.

c. If the most significant digit is incorrect, or if display is 101010, proceed to "Address Decoder Troubleshooting".

d. If only decimal point problems occur, check U19A.

e. If only OVER RANGE indicator problems occur, proceed to "Over Range Indicator Troubleshooting".

f. Check clock switch U12(6) for presence of clock signal. If U12(6) does not toggle, check U12(2) for clock signal and enable lines at U12(3) and U12(4).

g. Check data switch U6(8) for presence of input signal. If not present, check U6 and enable lines to U6.

h. Check TP2 for divided clock signal. If not present, check U10A, U13, and U21.

i. Check U10(15) for reset pulses. If not present, check U21 reset inverters.

j. Check TP1 for gated input signal. If not present, check U11B and U10B.

k. Check that U10B(12) toggles. If not, check Q4.

l. Check that U17A(3) toggles. If not, replace U17.

m. Check that TP3 toggles. If not, hold RESET button in and check for high levels at U11(8, 9, and 11). If pin 8 only is low, replace U11; if pin 9 or 11 is low, perform "Counter Circuit Troubleshooting".

n. Check that U9(4) toggles. If not, check U17B.

o. Set input frequency to 9 kHz, press 1K RESOLUTION switch, and set SAMPLE RATE to HOLD. Check that all inputs to U9 are low and that U9 outputs are as follows:

U9(16)	U9(14)	U9(8)	U9(10)
L	H	H	L

If inputs are bad, perform "Counter Circuit Troubleshooting". If outputs are bad, replace U9.

p. Change input frequency to 6 kHz and press RESET button once. Check that all inputs to U9 are high and that U9 outputs are as follows:

U9(16)	U9(14)	U9(8)	U9(10)
H	L	L	H

If inputs are bad, perform "Counter Circuit Troubleshooting". If outputs are bad, replace U9.

q. Set input frequency to 9.6 kHz and turn SAMPLE RATE control full ccw (not to OFF). Ensure that each of the four U18 outputs toggles. If not, replace U18. If outputs all toggle, perform "Address Decoder Troubleshooting".

9C-5-30. COUNTER CIRCUIT TROUBLESHOOTING. Perform this procedure only after performing "Both Channels Inoperative Troubleshooting", above.

a. Set input frequency to 9 kHz and press 1K RESOLUTION switch.

b. While holding RESET button in, check U7 and U8 for high levels at U7(6), U8(6), and U8(7) and for low levels at U7(5), U7(9), and U8(9). Replace either IC if it does not have the specified levels.

c. Release RESET button and check that U7 pins 5, 6, and 9 toggle. If not, replace U7.

d. Check that U8 pins 7 and 9 toggle. If not, replace U8.

e. Check that U11A(12) toggles. If not, replace U11. If U11A(12) toggles, replace U8.

9C-5-31. ADDRESS DECODER TROUBLESHOOTING. Troubleshoot the address decoder circuits as follows:

a. Set input frequency to 9 kHz and press 1K RESOLUTION switch.

b. Check for pulses at U19D(11). If not present, replace U19.

c. Check that U21B(6) pulses high. If not, replace U21.

d. Check for sharp, negative-going pulses at U19C(8). If present, replace U20. If not present, check U19B, U19C, and C15.

9C-5-32. Over Range Indicator Troubleshooting

9C-5-33. Troubleshoot the OVER RANGE indicator circuits as follows:

a. Set input frequency to 1.25 MHz and press the 1 Hz RESOLUTION switch. If OVER RANGE indicator lights, go to step e.

b. Check that U14A(5) and U14A(6) toggle. If not, check operation of U14A, Q3, CR2.

c. Check that U16B(6) is low. If not, replace U16.

d. Check that Q5 emitter is low. If not, replace Q5. If Q5 emitter is low, replace the OVER RANGE indicator, CR1.

e. Reduce input frequency to 900 kHz. If OVER RANGE indicator remains lit, check for high level at base of Q5. If high, replace Q5. If low, check for possibility of base to collector short before proceeding.

f. Check for high level at U16C(9). If high, replace U16; if low, replace U14.

9C-5-34. Option 001 Oscillator Troubleshooting

9C-5-35. Troubleshoot the option 001 oscillator circuits as follows:

a. Check for 10 MHz oscillator signal at TP5.

b. If signal is not present at TP5, check for signal at U5E(11). If signal is present at U5E(11), replace U5. If signal is not present at U5E(11), check S3, Y1, and associated components.

SECTION IX C

5303B 525 MHz COUNTER

SUBSECTION VI
REPLACEABLE PARTS

9C-6-1. INTRODUCTION

9C-6-2. This subsection contains information for ordering replacement parts. Table 9C-6-1 lists parts used in the HP 5303B. The table lists parts in alpha-numberical order of their reference designators and provides the following information on each part:

a. Hewlett-Packard part number.

b. Description of part (see abbreviations below).

c. Total quantity used in the instrument (the first time that the part appears in the list, the total quantity of that part number is printed).

d. Typical manufacturer of the part in a five-digit code (see list of manufacturer's in Table 9C-6-2).

e. Manufacturer's part number.

9C-6-3. Miscellaneous parts are listed at the end of Table 9C-6-1.

9C-6-3. ORDERING INFORMATION

9C-6-4. To obtain replacement parts, address order of inquiry to your local Hewlett-Packard Sales and Service office (see lists in Section VI 5300A manual for addresses). Identify parts by their Hewlett-Packard part number. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

A = assembly	F = fuse	MP = mechanical part	U = integrated circuit				
B = motor	FL = filter	P = plug	V = vacuum, tube, neon bulb, photocell, etc.				
BT = battery	IC = integrated circuit	Q = transistor					
C = capacitor	J = jack	R = resistor	VR = voltage regulator				
CP = coupler	K = relay	RT = thermistor	W = cable				
CR = diode	L = inductor	S = switch	X = socket				
DL = delay line	LS = loud speaker	T = transformer	Y = crystal				
DS = device signaling (lamp)	M = meter	TB = terminal board	Z = tuned cavity, network				
E = misc electronic part	MK = microphone	TP = test point					

ABBREVIATIONS

A = amperes	H = henries	N/O = normally open	RMO = rack mount only				
AFC = automatic frequency control	HDW = hardware	NOM = nominal	RMS = root-mean square				
AMPL = amplifier	HEX = hexagonal	NPO = negative positive zero (zero temperature coefficient)	RWV = reverse working voltage				
	HG = mercury						
BFO = beat frequency oscillator	HR = hour(s)		S-B = slow-blow				
BE CU = beryllium copper	HZ = hertz	NPN = negative-positive-negative	SCR = screw				
BH = binder head			SE = selenium				
BP = bandpass	IF = intermediate freq	NRFR = not recommended for field replacement	SECT = section(s)				
BRS = brass	IMPG = impregnated		SEMICON = semiconductor				
BWO = backward wave oscillator	INCD = incandescent	NSR = not separately replaceable	SI = silicon				
	INCL = include(s)		SIL = silver				
CCW = counter-clockwise	INS = insulation(ed)		SL = slide				
CER = ceramic	INT = internal	OBD = order by description	SPG = spring				
CMO = cabinet mount only		OH = oval head	SPL = special				
COEF = coefficient	K = kilo = 1000	OX = oxide	SST = stainless steel				
COM = common	LH = left hand	P = peak	SR = split ring				
COMP = composition	LIN = linear taper	PC = printed circuit	STL = steel				
COMPL = complete	LK WASH = lock washer	PF = picofarads = 10^{-12} farads	TA = tantalum				
CONN = connector	LOG = logarithmic taper		TD = time delay				
CP = cadmium plate	LPF = low pass filter	PH BRZ = phosphor bronze	TGL = toggle				
CRT = cathode-ray tube		PHL = Phillips	THD = thread				
CW = clockwise	M = milli = 10^{-3}	PIV = peak inverse voltage	TI = titanium				
	MEG = meg = 10^{6}	PNP = positive-negative-positive	TOL = tolerance				
DEPC = deposited carbon	MET FLM = metal film		TRIM = trimmer				
DR = drive	MET OX = metallic oxide	P/O = part of	TWT = traveling wave tube				
ELECT = electrolytic	MFR = manufacturer	POLY = polystyrene	U = micro = 10^{-6}				
ENCAP = encapsulated	MHZ = mega hertz	PORC = porcelain					
EXT = external	MINAT = miniature	POS = position(s)	VAR = variable				
F = farads	MOM = momentary	POT = potentiometer	VDCW = dc working volts				
FH = flat head	MOS = metal ozide substrate	PP = peak-to-peak					
FIL H = fillister head	MTG = mounting	PT = point	W/ = with				
FXD = fixed	MY = "mylar"	PWV = peak working voltage	W = watts				
G = giga (10^{9})	N = nano (10^{-9})	RECT = rectifier	WIV = working inverse voltage				
GE = germanium	N/C = normally closed	RF = radio frequency					
GL = glass	NE = neon	RH = round head or right hand	WW = wirewound				
GRD = ground(ed)	NI PL = nickel plate		W/O = without				

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Table 9C-6-1. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			LESS OPTION 001		
A1	05303-60007	1	BOARD ASSY: LOGIC (NOT AVAILABLE FOR FIELD REPLACEMENT OR SALE)	50443	05303-60007
A1C1			NOT ASSIGNED		
A1C2	0160-3878	22	C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C3	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C4	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C5	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C6	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C7	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C8	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C9	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C10	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C11	0180-1746	1	C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C12	0150-0075	3	C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C13	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X5U0-472Z
A1C14	0180-1702	2	C:FXD ELECT 180 UF 20% 6VDCW	56289	150D187X0006R2-DYS
A1C15	0150-0050	2	C: FXD CER 1000 PF +80 –20% 1000VDCW	56289	C067B102E102ZS26-CDH
A1C17	0180-1702		C: FXD ELECT 180 UF 20% 6VDCW	56289	150D187X0006R2-DYS
A1C18	0160-3878		C: FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C19	0160-3878		C: FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C20	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C21	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C22	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C23	0180-0228	2	C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A1C24	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A1CR1	1902-3002	2	DIODE:ZENER 2.37V	28480	1902-3002
A1CR2	1910-0034	2	DIODE:GERMANIUM 25V	28480	1910-0034
A1CR3	1910-0034		DIODE:GERMANIUM 25V	28480	1910-0034
A1CR4	1902-0031	1	DIODE BREAKDOWN:12.7V 5%	28480	1902-0031
A1CR5	1902-0025	1	DIODE,BREAKDOWN:10.0V 5% 400 MW	28480	1902-0025
A1CR6	1902-0041	1	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A1CR7	1901-0662	1	DIODE:SI, POWER RECTIFIER	04713	MR 751
A1CR8	1902-0554	2	DIODE BREAKDOWN:10V 1W	28480	1902-0554
A1CR9	1901-0050	2	DIODE:SI 200 MA AT 1V	07263	FDA 6308
A1CR10	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A1CR11	1902-0554		DIODE BREAKDOWN:10V 1W	28480	1902-0554
A1E1	5088-7002	1	IC:LIMITER	28480	5088-7002
A1F1	2110-0332	2	FUSE:3A	71400	GMW 3
A1F2	2110-0332		FUSE:3A	71400	GMW 3
A1F3	2110-0436	2	FUSE: 1/10A 125V	50443	2110-0436
A1F3 (SPARE)	2110-0436		FUSE: 1/10A 125V (SPARE 50Ω INPUT)	50443	2110-0436
A1J1	1260-0398	1	CONNECTOR:MALE PINS/BREAK-AWAY FRAME	28480	1260-0398
A1L1	9100-2276	1	COIL/CHOKE 100 UH 10%	28480	9100-2276
A1L2	05303-60004	2	INDUCTOR:FILTER	28480	05303-60004
A1L3	05303-60004		INDUCTOR:FILTER	28480	05303-60004
A1P1	1251-2756	1	CONNECTOR:R & P, 50 CONTACT	74868	57-20500-31
A1Q1	1854-0009	4	TSTR:SI NPN	80131	2N709
A1Q2	1853-0015	1	TSTR:SI PNP	80131	2N3640
A1Q3	1853-0036	2	TSTR:SI PNP	80131	2N3906
A1Q4	1854-0009		TSTR:SI NPN	80131	2N709
A1Q5	1853-0036		TSTR:SI PNP	80131	2N3906
A1R1	0683-1025	3	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A1R2			NOT ASSIGNED		
A1R3	0683-2025	6	R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A1R4	0683-5105	1	R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A1R5	2100-1775	1	R:VAR WW 5K OHM 5% TYPE H 1W	28480	2100-1775
A1R6			NOT ASSIGNED		
A1R7			NOT ASSIGNED		
A1R8	0698-3378	1	R:FXD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A1R9	0683-5115	2	R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A1R10	0683-1035	13	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R11			NOT ASSIGNED		
A1R12	0683-5115		R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A1R13	0683-3015	2	R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A1R14	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R15	0684-0271	1	R:FXD COMP 2.7 OHM 10% 1/4W	01121	CB 2761
A1R16	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R17	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A1R18	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R19	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R20	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R21	0683-3025	1	R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A1R22	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R23	0683-2405	1	R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405
A1R24	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R25	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035

See introduction to this section for ordering information

Table 9C-6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			LESS OPTION 001 (CONTINUED)		
A1S1	3101-1709	1	SWITCH:PUSHBUTTON DPDT 4-STATION	71590	PB-10
A1S2	3101-1708	1	SWITCH:PUSHBUTTON	28480	3101-1708
A1U1	5086-7089	1	IC:AMP AND TRIG	28480	5086-7089
A1U2	1820-0736	2	IC:DIGITAL	28480	1820-0736
A1U3	1820-0736		IC:DIGITAL	28480	1820-0736
A1U4	1820-0101	1	INTEGRATED CIRCUIT:DIFFERENTIAL AMPL	04713	MC1034P
A1U5			NOT ASSIGNED		
A1U6	1820-0691	1	IC:TTL SCHOTTKY 4 W(4-2-3-2)INPT	01295	SN74S64N
A1U7	1820-0629	3	IC:TTL SHS DUAL EDGE TRIG. J-K F/F	01295	SN74S112N
A1U8	1820-0629		IC:TTL SHS DUAL EDGE TRIG. J-K F/F	01295	SN74S112N
A1U9	1820-0876	1	IC:4-BIT LATCH	01295	SN74L75N
A1U10	1820-0629		IC:TTL SHS DUAL EDGE TRIG. J-K F/F	01295	SN74S112N
A1U11	1820-0686	1	IC:TTL SCHOTTKY TRIPLE 3-INPT AND GATE	01295	SN74S11N
A1U12	1820-0072	1	IC:TTL DUAL 2W 2-INPT AND/OR GATE	01295	SN7450N
A1U13	1820-0055	1	IC:TTL DECADE COUNTER	01295	SN7490N
A1U14	1820-0596	2	IC:TTL LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A1U15	1820-0077	1	IC:TTL DUAL D F/F	01295	SN7474N
A1U16	1820-0583	3	IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L00N
A1U17	1820-0583		IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L00N
A1U18	1820-0585	1	IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L03N
A1U19	1820-0583		IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L00N
A1U20	1820-0596		IC:TTL LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A1U21	1820-0307	1	IC:DIGITAL DTL HEX INVERTER		
A1XF1	1400-0110	2	BODY:FUSEHOLDER	71400	P/O HWA HOLDER
A1XF2	1400-0110		BODY:FUSEHOLDER	71400	P/O HWA HOLDER
A1XF3	1251-3205	4	SOCKET:MINIATURE SINGLE LEAD	28480	1251-3205
A1XU1	1200-0475	30	SOCKET:IC SINGLE LEAD	70998	75060-00
A1XU2	1200-0475		SOCKET:IC SINGLE LEAD	70998	75060-00
A2	05303-60008	1	BOARD ASSY:AMPLIFIER	50443	05303-60008
A2C1	0180-0210	4	C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A2C2	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X500-472Z
A2C3	0150-0050		C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C067B102E102Z526-CDH
A2C4	0180-0210		C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A2C5	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A2C6	0180-0210		C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A2C7	0140-0209	1	C:FXD MICA 5.0 PF 10%	28480	0140-0209
A2C8	0180-0210		C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
A2C9	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A2C10	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A2C11	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A2C12	0180-0106	1	C:FXD ELECT 6U UF 20% 6VDCW	28480	0180-0106
A2C13	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A2C14	0180-1701	2	C:FXD ELECT 6.8 UF 20% 6VDCW	28480	0180-1701
A2C15	0180-1701		C:FXD ELECT 6.8 UF 20% 6VDCW	28480	0180-1701
A2C16	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A2C17	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A2C18	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A2CR1	1901-0040	2	DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR3	1901-0179	4	DIODE:SILICON 15WV	28480	1901-0179
A2CR4	1901-0179		DIODE:SILICON 15WV	28480	1901-0179
A2CR5	1901-0179		DIODE:SILICON 15WV	28480	1901-0179
A2CR6	1901-0179		DIODE:SILICON 15WV	28480	1901-0179
A2CR7	1902-3002	1	DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A2MP1	03431-01201	2	BRACKET:MOUNTING CKT BD	50443	03431-01201
A2P1	1200-0432	6	SOCKET:FEMALE SINGLE	27264	1200-0432
A2Q1	1855-0081	1	TSTR:SI FET	80131	1855-0081
A2Q2	1853-0247	1	TSTR:SI PNP	01295	1853-0247
A2Q3	1854-0019	1	TSTR:SI NPN	28480	1854-0019
A2Q4	1854-0009		TSTR:SI NPN	80131	2N709
A2Q5	1854-0092	2	TSTR:SI NPN	80131	2N3563
A2Q6	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q7	1854-0009		TSTR:SI NPN	80131	2N709
A2R1	0683-1045	2	R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A2R2	0683-2015	1	R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A2R3	0683-1055	1	R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A2R4	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A2R5	0683-7515	2	R:FXD COMP 750 OHM 5% 1/4W	01121	CB 7515
A2R6	0683-2425	1	R:FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A2R7	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A2R8	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A2R9	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R10	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025

See introduction to this section for ordering information

Table 9C-6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			LESS OPTION 001 (CONTINUED)		
A2R11	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R12	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A2R13	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R14	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R15	0683-1835	1	R:FXD COMP 18K OHM 5% 1/4W	01121	CB 1835
A2R16	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R17	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A2R18	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R19	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A2R20	0683-4715	1	R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A2R21	0683-3015		R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A2R22	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A2R23	0683-1015	1	R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R24	0683-7515		F:FXD COMP 750 OHM 5% 1/4W	01121	CB 7515
A2U1	1820-0270	1	IC:DIFFERENTIAL VIDEO AMP	07263	U5F7733393
A2U2	1820-0216	1	IC:OP. AMP. AVOL=50K MIN.	28480	1820-0216
			MISCELLANEOUS AND CHASSIS PARTS		
DS1	1990-0325	1	DIODE:VISIBLE LIGHT EMITTER	28480	1990-0325
J1			PART OF W1		
J2	1250-0186	1	CONNECTOR:BNC INPUT RF	28480	30380-1
J3	1251-1816	1	CONNECTOR:BANANA FEM RED	28480	1251-1816
J4	1251-0463	1	CONNECTOR:BANANA FEM BLK	94137	1251-0463
W1	05303-60006	1	CABLE ASSEMBLY:50 OHM	28480	05303-60006
W2	05303-60010	1	CABLE ASSEMBLY:1 MEGOHM	50443	05303-60010
	0360-1190	1	LUG:SOLDER B.N.C (J2)	79963	720 SPEC
	0370-0914	7	BEZEL:PUSHBUTTON KNOB, JAD GREY	28480	0370-0914
	0370-0970 OR	7	PUSHBUTTON ASSY:BLANK (BLANK AND GRAY)	28480	0370-0970
	0370-2486	7	PUSHBUTTON ASSY:BLANK (SOLID GRAY)	28480	0370-2486
	1400-0249	1	STRAP:CABLE, GRAY NYLON	59730	TYB-23M-B
	1400-0808	1	DIODE HOLDER:CLEAR PLASTIC (FOR DS1)	28480	1400-0808
	3050-0279	1	WASHER:FIBER 7/16" OD 1/4" ID (FOR DS1)	82389	S-1564
5040-0345	5040-0345	2	INSULATOR:CONNECTOR (FOR J2)	28480	5040-0345
	5040-7032	1	FOOT:REAR	28480	5040-7032
	05300-20010	1	CASE	28480	05300-20010
	05300-40003	4	SUPPORT:BOARD	28480	05300-40003
	05300-40004	4	GUIDE:SLIDE 1	28480	05300-40004
	05301-20005	1	STAND:TILT	28480	05301-20005
	05301-40001	1	FOOT:FRONT	28480	05301-40001
	05303-00003	1	PANEL:FRONT	50443	05303-00003
	05303-00004	2	BRACKET:FRONT	50443	05303-00004
	05303-00005	1	PANEL:REAR	50443	05303-00005

See introduction to this section for ordering information

Table 9C-6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			WITH OPTION 001		
A1	05303-60011	1	BOARD ASSY: LOGIC (NOT AVAILABLE FOR FIELD REPLACEMENT OR SALE)	50443	05303-60011
A1C1	0150-0075	4	C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X500-472Z
A1C2	0160-3878	22	C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C3	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C4	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C5	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C6	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C7	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C8	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C9	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C10	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C11	0180-1746	1	C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746
A1C12	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X500-472Z
A1C13	0150-0075		C:FXD CER 4700 PF +100-20% 500VDCW	72982	851-000-X500-472Z
A1C14	0180-1702	2	C:FXD ELECT 180 UF 20% 6VDCW	56289	150D187X0006R2-DYS
A1C15	0150-0050	2	C:FXD CER 1000 PF +80-20% 1000VDCW	56289	C0678102E102ZS26-CDH
A1C17	0180-1702		C:FXD ELECT 180 UF 20% 6VDCW	56289	150D187X0006R2-DYS
A1C18	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C19	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C20	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C21	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C22	0160-3878		C:FXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A1C23	0180-0228	2	C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A1C24	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A1C25	0180-1701	4	C:FXD ELECT 6.8 UF 20% 6VDCW	28480	0180-1701
A1C26	0180-1701		C:FXD ELECT 6.8 UF 20% 6VDCW	28480	0180-1701
A1CR1	1902-3002	2	DIODE:ZENER 2.37V	28480	1902-3002
A1CR2	1910-0034	2	DIODE:GERMANIUM 25V	28480	1910-0034
A1CR3	1910-0034		DIODE:GERMANIUM 25V	28480	1910-0034
A1CR4	1902-0031	1	DIODE BREAKDOWN:12.7V 5%	28480	1902-0031
A1CR5	1902-0025	1	DIODE,BREAKDOWN:10.0V 5% 400 MW	28480	1902-0025
A1CR6	1902-0041	1	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A1CR7	1901-0662	1	DIODE:SI, POWER RECTIFIER	04713	MR 751
A1CR8	1902-0554	2	DIODE BREAKDOWN:10V 1W	28480	1902-0554
A1CR9	1901-0050	2	DIODE:SI 200 MA AT 1V	07263	FDA 6308
A1CR10	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A1CR11	1902-0554		DIODE BREAKDOWN:10V 1W	28480	1902-0554
A1E1	5088-7002	1	IC:LIMITER	28480	5088-7002
A1F1	2110-0332	2	FUSE:3A	71400	GMW 3
A1F2	2110-0332		FUSE:3A	71400	GMW 3
A1F3	2110-0436	2	FUSE:1/10A 125V	50443	2110-0436
A1F3 (SPARE)	2110-0436		FUSE:1/10A 125V (SPARE 50Ω INPUT)	50443	2110-0436
A1J1	1260-0398	1	CONNECTOR:MALE PINS/BREAK-AWAY FRAME	28480	1260-0398
A1L1	9100-2276	3	COIL/CHOKE 100 UH 10%	28480	9100-2276
A1L2	05303-60004	2	INDUCTOR:FILTER	28480	05303-60004
A1L3	05303-60004		INDUCTOR:FILTER	28480	05303-60004
A1L4	9100-2276		COIL/CHOKE 100 UH 10%	28480	9100-2276
A1L5	9100-2276		COIL/CHOKE 100 UH 10%	28480	9100-2276
A1P1	1251-2756	1	CONNECTOR:R & P, 50 CONTACT	74868	57-20500-31
A1Q1	1854-0009	4	TSTR:SI NPN	80131	2N709
A1Q2	1853-0015	1	TSTR:SI PNP	80131	2N3640
A1Q3	1853-0036	2	TSTR:SI PNP	80131	2N3906
A1Q4	1854-0009		TSTR:SI NPN	80131	2N709
A1Q5	1853-0036		TSTR:SI PNP	80131	2N3906
A1R1	0683-1025	3	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A1R2	0683-7515	3	R:FXD COMP 750 OHM 5% 1/4W	01121	CB 7515
A1R3	0683-2025	7	R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A1R4	0683-5105	2	R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A1R5	2100-1775	1	R:VAR WW 5K OHM 5% TYPE H 1W	28480	2100-1775
A1R6	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A1R7	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A1R8	0698-3378	1	R:FXD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A1R9	0683-5115	2	R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A1R10	0683-1035	13	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R11	0684-0271	1	R:FXD COMP 2.7 OHM 10% 1/4W	01121	CB 27G1
A1R12	0683-5115		R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A1R13	0683-3015	1	R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A1R14	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R15			NOT ASSIGNED		
A1R16	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035

Table 9C-6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			WITH OPTION 001 (CONTINUED)		
A1R17	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A1R18	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R19	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R20	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R21	0683-3025	1	R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A1R22	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R23	0683-2405	1	R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405
A1R24	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1R25	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A1S1	3101-1709	1	SWITCH:PUSHBUTTON DPDT 4-STATION	71590	PB-10
A1S2	3101-1708	1	SWITCH:PUSHBUTTON	28480	3101-1708
A1S3	3101-1596	1	SWITCH:SLIDE DPDT MINIATURE	78488	3S-91-1
A1U1	5086-7089	1	IC:AMP AND TRIG	28480	5086-7089
A1U2	1820-0736	2	IC:DIGITAL	28480	1820-0736
A1U3	1820-0736		IC:DIGITAL	28480	1820-0736
A1U4	1820-0101	1	INTEGRATED CIRCUIT:DIFFERENTIAL AMPL	04713	MC1034P
A1U5	1820-0174	1	IC:TTL HEX INVERTER	01295	SN7404N
A1U6	1820-0691	1	IC:TTL SCHOTTKY 4 W(4-2-3-2)INPT	01295	SN74S64N
A1U7	1820-0629	3	IC:TTL SHS DUAL EDGE TRIG. J-K F/F	01295	SN74S112N
A1U8	1820-0629		IC:TTL SHS DUAL EDGE TRIG. J-K F/F	01295	SN74S112N
A1U9	1820-0876	1	IC:DIGITAL LP QUAD 4-BIT, TTL	01295	SN74L75N
A1U10	1820-0629		IC:TTL SHS DUAL EDGE TRIG. J-K F/F	01295	SN74S112N
A1U11	1820-0686	1	IC:TTL SCHOTTKY TRIPLE 3-INPT AND GATE	01295	SN74S11N
A1U12	1820-0072	1	IC:TTL DUAL 2W 2-INPT AND/OR GATE	01295	SN7450N
A1U13	1820-0055	1	IC:TTL DECADE COUNTER	01295	SN7490N
A1U14	1820-0596	2	IC:TTL LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A1U15	1820-0077	1	IC:TTL DUAL D F/F	01295	SN7474N
A1U16	1820-0583	3	IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L00N
A1U17	1820-0583		IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L00N
A1U18	1820-0585	1	IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L03N
A1U19	1820-0583		IC:TTL LP QUAD 2-INPT NAND GATE	12040	DM74L00N
A1U20	1820-0596		IC:TTL LP DUAL EDGE TRIG, D F/F	12040	DM74L74N
A1U21	1820-0307	1	IC:DIGITAL DTL HEX INVERTER		
A1XF1	1400-0110	2	BODY:FUSEHOLDER	71400	P/O HWA HOLDER
A1XF2	1400-0110		BODY:FUSEHOLDER	71400	P/O HWA HOLDER
A1XF3	1251-3205	4	SOCKET:MINIATURE SINGLE LEAD	28480	1251-3205
A1XU1	1200-0475	30	SOCKET:IC SINGLE LEAD	70998	75060-00
A1XU2	1200-0475		SOCKET:IC SINGLE LEAD	70998	75060-00
A1Y1	0960-0318	1	CRYSTAL OSCILLATOR:10 MHz	28480	0960-0318
J5	1250-0083	1	CONNECTOR:BNC	02660	31-221-1020

See introduction to this section for ordering information

Table 9C-6-2. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.	53204
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
02660	AMPHENOL CORP.	BROADVIEW, ILL.	60153
04713	MOTOROLA SEMICONDUCTOR PROD.INC.	PHOENIX, ARIZ.	85008
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
12040	NATIONAL SEMICONDUCTOR CORP.	DANBURY, CONN.	06810
27264	MOLEX PROD. CO.	DOWNERS GROVE, ILL.	60515
28480	HEWLETT-PACKARD CO. CORPORATE HQ	PALO ALTO, CALIF.	94304
50443	HEWLETT-PACKARD CO. SANTA CLARA DIV	SANTA CLARA, CALIF.	95050
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
59730	THOMAS & BETTS CO. THE	ELIZABETH, N.J.	07207
70998	BIRD ELECTRONICS CORP.	CLEVELAND, OHIO	44139
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.	63017
71590	GLOBE UNION INC. CENTRALAB DIV.	MILWAUKEE, WISC.	53201
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
74868	AMPHENOL CORP. RF DIV.	DANBURY, CONN	06810
77068	BENDIX CORP. ELECTRODYNAMICS DIV.	N. HOLLYWOOD, CALIF.	91605
79963	ZIERICK MFG. CO.	MT. KISCO, N.Y.	10549
80031	MEPCO DIV. SESSIONS CLOCK CO.	MORRISTOWN, N.J.	07960
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.	20006
82389	SWITCHCRAFT INC.	CHICAGO, ILL.	60630
94137	NO M/F DESCRIPTION FOR THIS MFG NUMBER		

SECTION IX C

5303B 525 MHz COUNTER

SUBSECTION VII
MANUAL CHANGES AND OPTIONS

9C-7-1. MANUAL CHANGES

9C-7-2. Section IX C applies directly to Model 5303B 525 MHz Counters having serial number prefix 1240A.

9C-7-3. Newer Instruments

9C-7-4. As changes are made, newer instruments may have serial number prefixes not listed in Section IX C. The manuals for these instruments will be supplied with "Manual Changes" sheets containing the required information; replace the affected pages with the replacement "manual changes" pages. Contact the nearest Hewlett-Packard Sales and Service Office for information if these pages are missing.

9C-7-5. Older Instruments

9C-7-6. The following paragraphs give the information necessary to modify the manual to cover instruments with serial number prefixes 1232A and 1208A.

9C7-7. SERIAL PREFIX 1208A UNITS. The EXT dc jacks on the rear panel of the instrument are labelled "EXT DC, 12-30 V" instead of "EXT DC 11-24 V". Note this difference, then make all the changes listed below for serial prefix 1232A units.

9C-7-8. SERIAL PREFIX 1232A UNITS. Make the following manual changes to adapt this section of the manual to units having serial number prefix 1232A:

a. Add capacitor A1C16, part number 0150-0073, 100 pF, 10%, 1000VDCW to the replaceable parts lists on pages 9C-6-2 and 9C-6-5. Additionally, remove gate A1U19B and add A1C16 to the schematic diagram and add A1C16 to the component location photograph of Figure 9C-8-2 (see Figure 9C-7-1 for locations).

b. In the replaceable parts lists on pages 9C-6-2 and 9C-6-5, change the entries for A1CR1, A1Q2, A1R9, and A1R21 to the following:

A1CR1, 1902-3057, DIODE:ZENER 3.74V

A1Q2, 1854-0009, TSTR:SI NPN, 2N709

A1R9, 0683-7515, R:FXD COMP 750 OHM 5% ¼W

A1R21, 0683-1025, R:FXD COMP 1000 OHM 5% ¼W

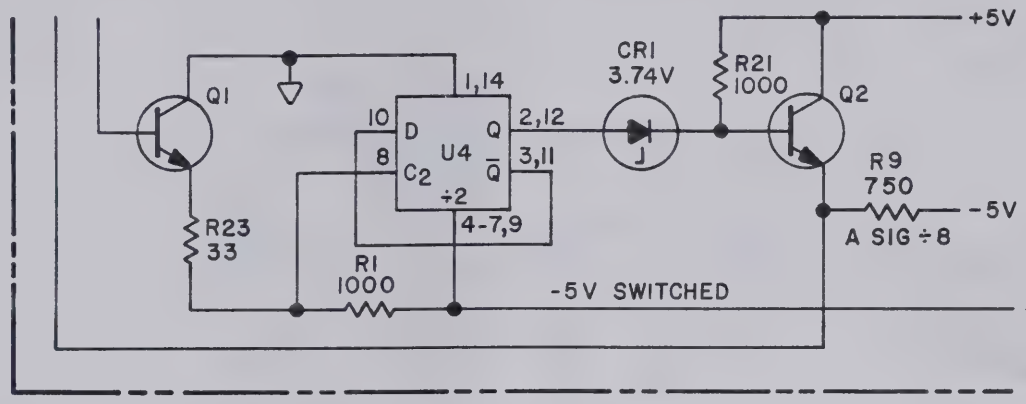
Additionally, change the schematic diagram in Figure 9C-8-2 to conform to these component changes as shown in Figure 9C-7-1.

9C-7-9. OPTIONS

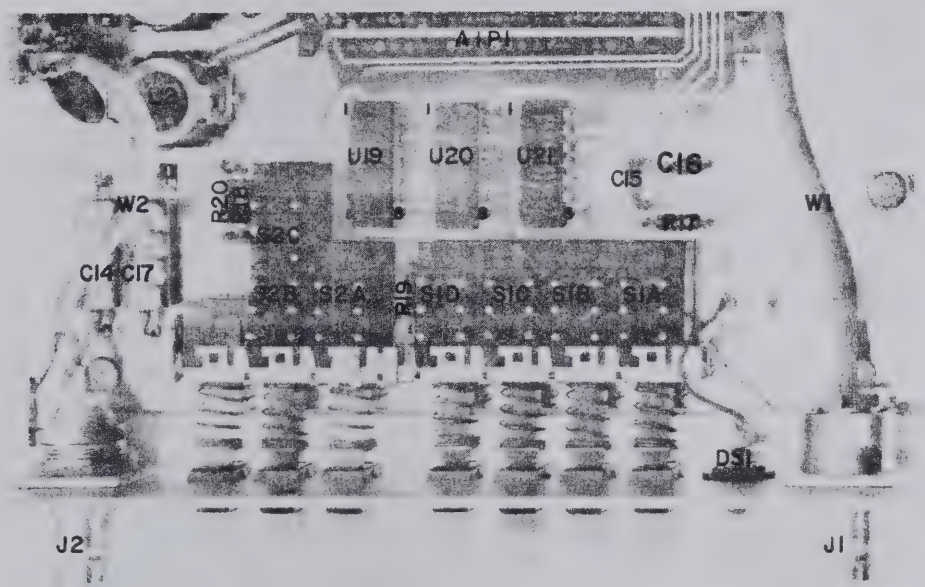
9C-7-10. Option 001 is a high-stability time base oscillator for the 525 MHz Counter. Specifications for this option are included in Table 9C-1-1. The schematic diagram for the A1 Logic Board includes the option 001 circuits in dotted line form.

9C-7-11. Option 001 may be installed in the field. Refer to Figure 9C-7-2 for part numbers of all additional components required and for the physical placement of each component.

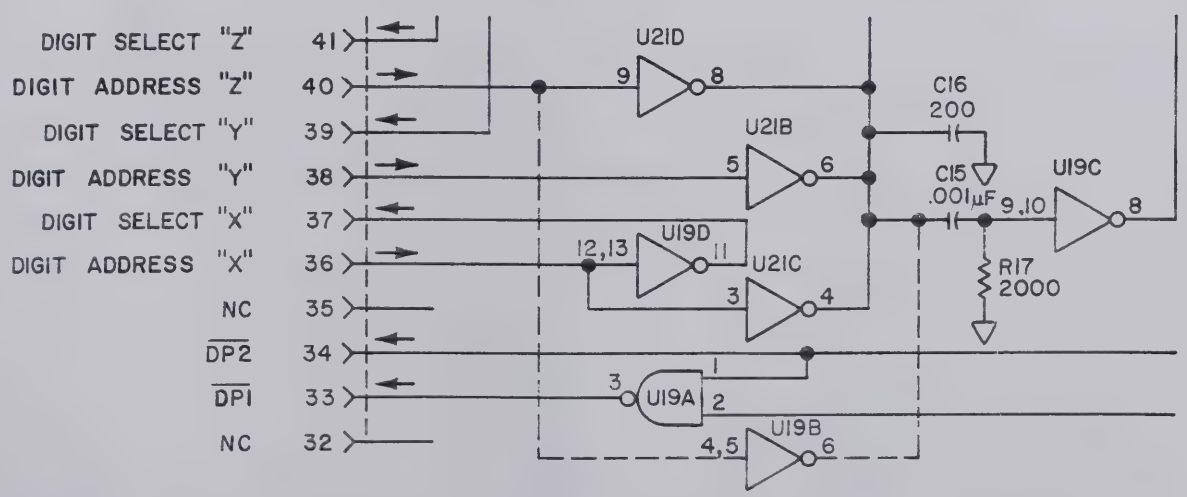
Figure 9C-7-1. Changes Required for Older Instruments



CHANGE CR1, R21, Q2, AND R9 ON SCHEMATIC DIAGRAM OF FIGURE 9C-8-2 TO THE CONFIGURATION SHOWN.

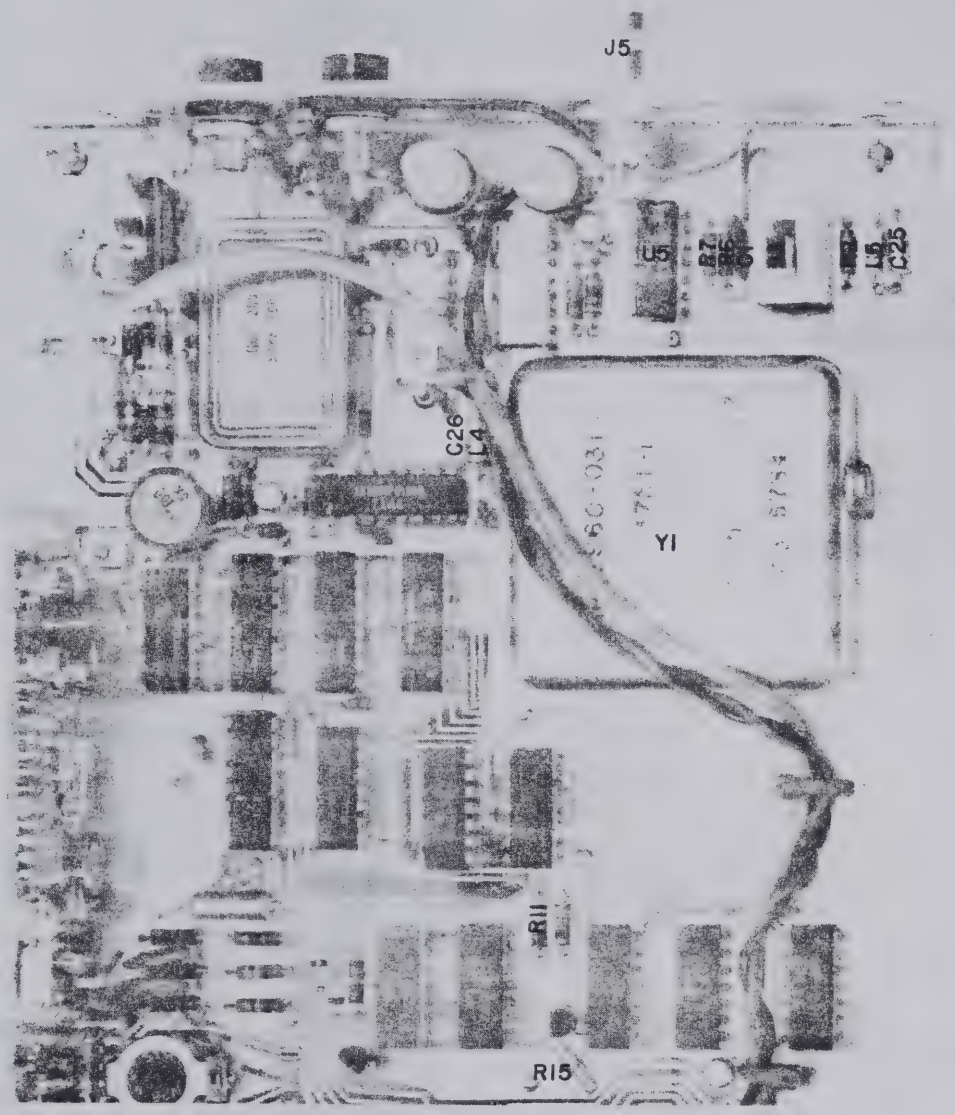


ADD C16 TO FIGURE 9C-8-2 COMPONENT LOCATION VIEW.



ON SCHEMATIC DIAGRAM OF FIGURE 9C-8-2, ADD C16, DELETE U19B,AND CONNECT C15 TO THE OUTPUTS OF U21B, C, AND D.

Figure 9C-7-2. Field Installation of Option 001



NOTE

1. REMOVE RESISTOR R15 AND INSTALL THE RESISTOR IN THE POSITION DESIGNATED FOR R11.
2. INSTALL THE FOLLOWING COMPONENTS IN THE POSITIONS INDICATED ABOVE.

REF. DESIG.	DESCRIPTION	HP PART NO.
C1	CAP: 4700 pF	0150-0075
C25	CAP: 6.8 µF	0180-1701
C26	CAP: 6.8 µF	0180-1701
J5	CONN: BNC	1250-0083
L4	COIL: 100 µH	9100-2276
L5	COIL: 100 µH	9100-2276
R2	RES: 750 OHM	0683-7515
R6	RES: 51 OHM	0683-5105
R7	RES: 2K OHM	0683-2025
R11	RES: 2.7 OHM	0684-0271
S3	SWITCH: DPDT	3101-1596
U5	IC: SN7404N	1820-0174
Y1	OSC: CRYSTAL	0960-0318

SECTION IX C

5303B 525 MHz COUNTER

SUBSECTION VIII
CIRCUIT DIAGRAMS

9C-8-1. INTRODUCTION

9C-8-2. This subsection of the manual contains the following information:

a. A signal list that gives the signal name and connector pin number of each signal that interconnects with the mainframe (see Table 9C-8-1).

b. A block diagram of the counter (see Figure 9C-8-1).

c. Signal waveforms at key points in the input amplifiers and clock circuits (part of Figure 9C-8-2).

d. Component location views of the printed-circuit boards (part of Figure 9C-8-2).

e. A schematic diagram of the counter (part of Figure 9C-8-2).

9C-8-3. Use the information in this subsection in conjunction with the information provided in Subsection V, Maintenance, while troubleshooting the counter.

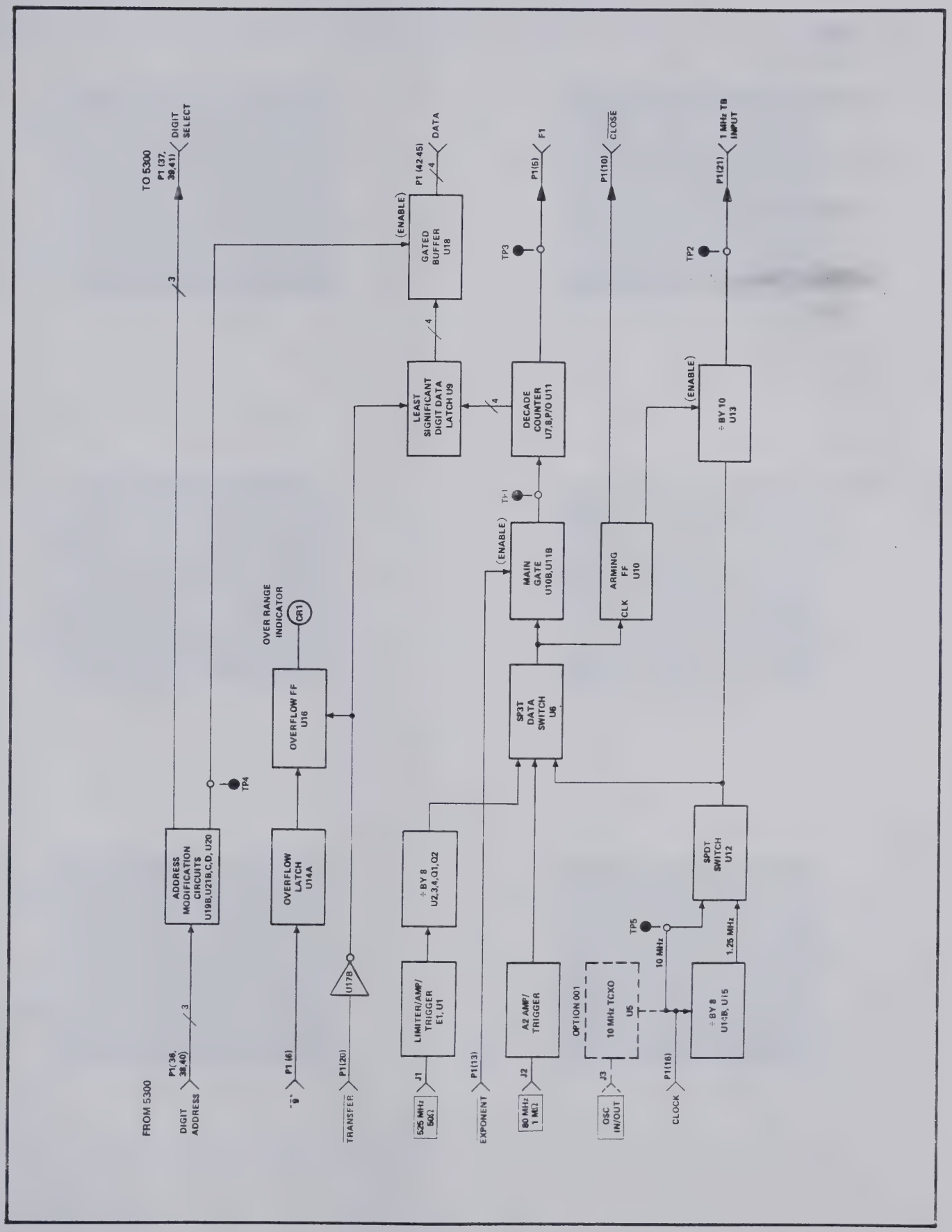
Table 9C-8-1. Counter Signal List

PIN NO.	SIGNAL NAME	DESCRIPTION
1	+5 V	Circuit operating voltages
2	-5 V	
3	NC	
4	COMMON RETURN	Common power and signal return line.
5	F1	Signal to be counted in the mainframe.
6	$\overline{\text{"9"}}$	Goes low when the mainframe counter reaches 9% full scale.
7	NC	
8	$\overline{\text{INHIBIT}}$	High during the measurement cycle, low during the display cycle.
9	$\overline{\text{OPEN}}$	Low signal forces the main gate flip-flop in the mainframe to the open position.
10	$\overline{\text{CLOSE}}$	Low signal forces the main gate flip-flop in the mainframe to the closed position.
11	NC	
12	NC	
13	$\overline{\text{EXPONENT}}$	Inverted log pulses while main gate in mainframe is open indicates number of auto-ranging steps.
14	NC	
15	RESET	High signal resets all registers.
16	CLOCK	10 MHz reference signal from mainframe crystal oscillator.
17	$\overline{\text{MAX TIME}}$	Low signal enables closing of the main gate in the mainframe on next log pulse. Rising edge initiates display cycle.
18	TIME BASE OUTPUT	Output from the time base decade that is selected by the time base select code on pins 22, 23, and 24.

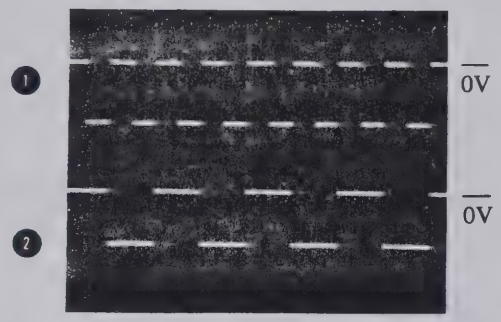
Table 9C-8-1. Counter Signal List (Continued)

PIN NO.	SIGNAL NAME	DESCRIPTION
19	$\overline{\text{PRINT}}$	Low signal provides print command to rear panel connector on mainframe.
20	$\overline{\text{TRANSFER}}$	Low signal transfers data to display. High signal stores data.
21	1 MHz TIME BASE INPUT	Input direct from plug-on bypasses control circuit.
22	TIME BASE SELECT A	Time base select code A, B, and C determines the time base frequency at the time base output, pin 18.
23	TIME BASE SELECT B	
24	TIME BASE SELECT C	
25	+22 V	Full wave rectified voltage from the power transformer secondary. Provides power to charge the battery pack. If no battery pack is used, pin 25 is connected via the plug-on to pin 50 (DC-IN).
26	+17 V	
27	$\overline{\text{Hz}}$	Pins 27 through 31 provide the drive to the annunciator lights on the front panel. A low signal lights the corresponding indicator.
28	$\overline{\text{M}}$	
29	NC	
30	$\overline{\text{K}}$	
31	NC	
32	NC	
33	$\overline{\text{DP1}}$	Low signal activates decimal point 1.
34	$\overline{\text{DP2}}$	Low signal activates decimal point 2.
35	NC	
36	DIGIT ADDRESS X	Digit address code X, Y, Z from the display scanner indicates which data digit is being displayed.
37	DIGIT SELECT X	Digit select code X, Y, Z is the code that selects the mainframe counter digit that is to be displayed. If the mainframe counter is displayed directly, the corresponding lines of the digit address code and the digit select code are connected together.
38	DIGIT ADDRESS Y	
39	DIGIT SELECT Y	
40	DIGIT ADDRESS Z	
41	DIGIT SELECT Z	
42	DATA "D"	The data code A, B, C, D represents the digit to be displayed in binary coded decimal form. Data lines can carry the mainframe counter information to the plug-on as well as to the display or can bypass the counter and bring plug-on data to the display.
43	DATA "C"	
44	DATA "B"	
45	DATA "A"	
46	$\overline{\text{DP3}}$	Low signal activates decimal point 3.
47	NC	
48	NC	
49	COMMON RETURN	Common power and signal return line.
50	DC IN	DC Power to power supply from battery pack or from 22 volt input power at pin 25.

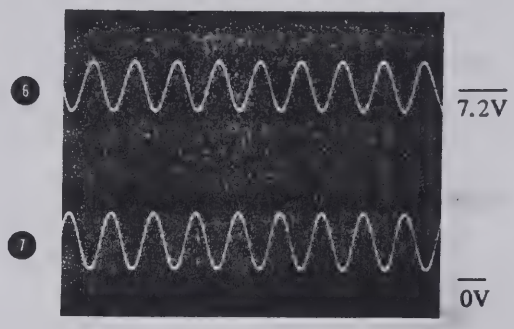
Figure 9C-8-1. Simplified Block Diagram



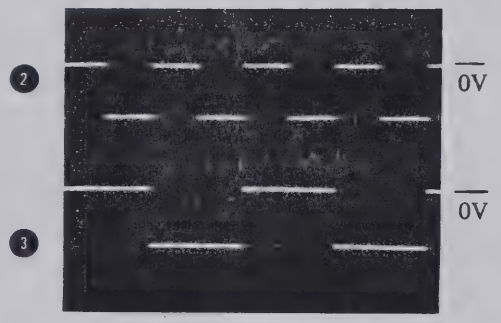
Part of Figure 9C-8-2. Signal Waveforms



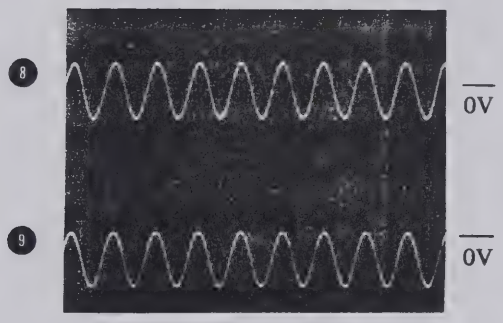
.05V/DIV, .1 MS/DIV



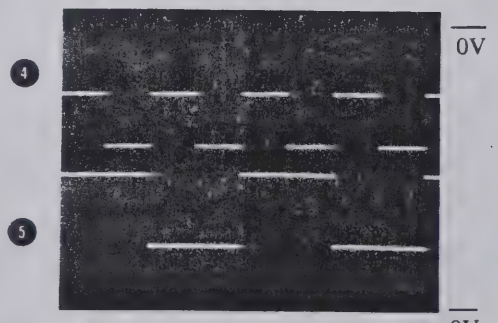
.2V/DIV, .1 MS/DIV



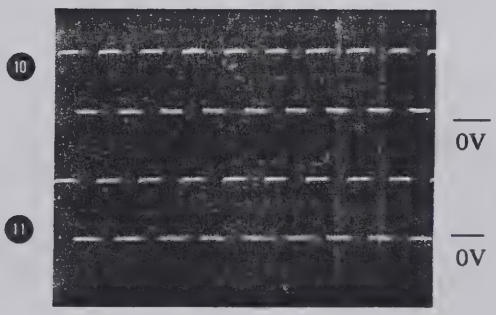
.05V/DIV, .1 MS/DIV



.2V/DIV, .1 MS/DIV



.05V/DIV, .2 MS/DIV



.2V/DIV, .1 MS/DIV

All waveforms taken with a 10:1 divider probe, dc coupling, and display control set to chop. Input signals are 9 kHz, 1V rms sine waves.

HEWLETT PACKARD

MANUAL CHANGES

MANUAL DESCRIPTION

INSTRUMENT: 5303B 525 MHz Counter

SERIAL PREFIX: 1240A

DATE PRINTED: MAR 1973
HP PART NO: 05303-90010
MICROFICHE NO: 05303-90011

CHANGE DATE October 17, 1974

(This change supersedes all earlier dated changes)

- Make all changes listed as ERRATA.
- Check the following table for your instrument's serial prefix or serial number and make listed change(s) to manual.

IF YOUR INSTRUMENT HAS SERIAL PREFIX OR SERIAL NUMBER	MAKE THE FOLLOWING CHANGES TO YOUR MANUAL	IF YOUR INSTRUMENT HAS SERIAL PREFIX OR SERIAL NUMBER	MAKE THE FOLLOWING CHANGES TO YOUR MANUAL
1412A	1		
►1428A	1,2		

► NEW OR REVISED ITEM

ERRATA

Page 9C-6-3, Table 9C-6-1:
Change A2P1 from 1200-0432 to 1200-0464; Mfr Code 00779; 3-116141-3.

Page 9C-6-4, Table 9C-6-1:
Change 1400-0826 to 1400-0808.

Page 9C-6-7, Table 9C-6-2:
Add "00779 AMP INC. (AIRCRAFT MARINE PROD) HARRISBURG, PA. 17101.

CHANGE 1 (1412A)

Page 9C-6-3/4:
Change A2R9, 11 from 0683-1035 to 0683-1025 1000 OHM.
Add A2E1 9170-0029 BEAD: FERRITE.

Page 9C-8-5, Figure 9C-8-2:
Trace is added between A1P1 pins (6) and (14).
Change Series numbers at top of schematic (2 places) to 1412A.
Change value A2R9, 11 from 10K to 1K.
Add to collector lead of A2Q2 ferrite bead A2E1.
Change SERIES number at top of A2 schematic to 1412A.

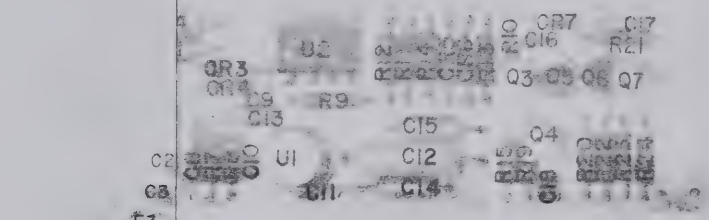
►CHANGE 2 (1428A)

Page 9C-6-2, Table 9C-6-1:
Change A1C2, 3 from 0160-3878 to 0160-3879 .01 UF.
Add A1L4 0503-80001 INDUCTOR: FILTER.
Change A1R8 from 0698-3378 to 0698-3379 68 OHM.
Change A1U1 to "5086-7089 or 5088-7008" (5088-7008 is preferred part).

Page 9C-8-5, Figure 9C-8-2:
Change value A1C2,3 from .001 to .01 UF.
Add A1L4 between U2(13) and junction U1(11), R8.
Change A1R8 from 51 to 68* OHM.
Change A1U1 (in Table of Active Components) from 5088-7001 to 5086-7089 or 5088-7008.
With these changes Board Series No. is 1428.

MANUAL PART NO. 05303-90010
MICROFICHE PART NO. 05303-90011

PRINTED IN U.S.A.



320-0596
320-0077
320-0583
320-0583
320-0585
320-0307
960-0318

901-0040
W2 901-0179
902-3002
C14 C1 355-0081
353-0247
354-0019
354-0009
354-0092
320-0270
320-0216

J2

990-0325

NOTES

1. Reference designations within this assembly are abbreviated. Add assembly number to abbreviation for complete description.
2. Unless otherwise indicated:

 Resistance in ohms.
 Capacitance in picofarads.
 Inductance in microhenries.
3. For Option 001, R15 is physically removed and becomes R11.
4. Dotted portion of schematic indicates Option 001.

Figure 9C-8-2. A1 Logic Board Assembly With Option 001

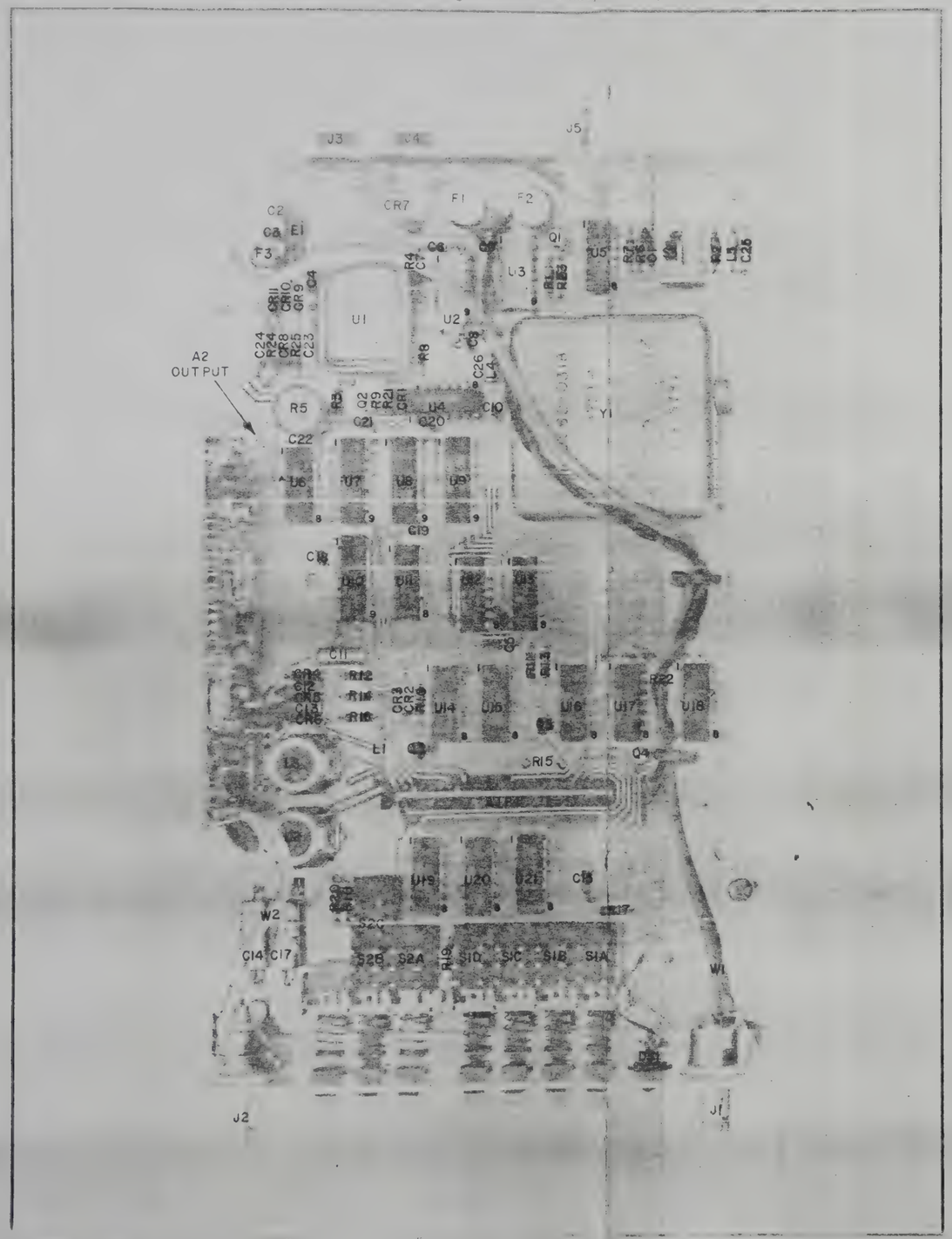


Figure 9C-8-2. A1 Logic Board Assembly With Option 001

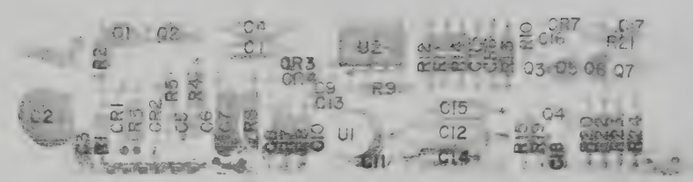


Table of Active Components

A1 Logic Board		U14, 20	1820-0596
CR1	1902-3002	U15	1820-0077
CR2, 3	1910-0034	U16, 17,	1820-0583
CR4	1902-0031	19	1820-0583
CR5	1902-0025	U18	1820-0585
CR6	1902-0041	U21	1820-0307
CR7	1901-0662	Y1	0960-0318
CR8, 11	1902-0554		
CR9, 10	1901-0050	**A2 Amplifier**	
Q1	1854-0009		
Q2	1853-0015	CR1, 2	1901-0040
Q3	1853-0036	CR3-6	1901-0179
Q4	1854-0009	CR7	1902-3002
Q5	1853-0036	Q1	1855-0081
U1	5088-7001	Q2	1853-0247
U2	1820-0736	Q3	1854-0019
U3	1820-0557	Q4, 7	1854-0009
U4	1820-0101	Q5, 6	1854-0092
U5	1820-0174	U1	1820-0270
U6	1820-0691	U2	1820-0216
U7,8,10	1820-0629		
U9	1820-0876	**No Prefix**	
U11	1820-0686		
U12	1820-0072	DS1	1990-0325
U13	1820-0055		

NOTES

1. Reference designations within this assembly are abbreviated. Add assembly number to abbreviation for complete description.
2. Unless otherwise indicated:
 Resistance in ohms.
 Capacitance in picofarads.
 Inductance in microhenries.
3. For Option 001, R15 is physically removed and becomes R11.
4. Dotted portion of schematic indicates Option 001.

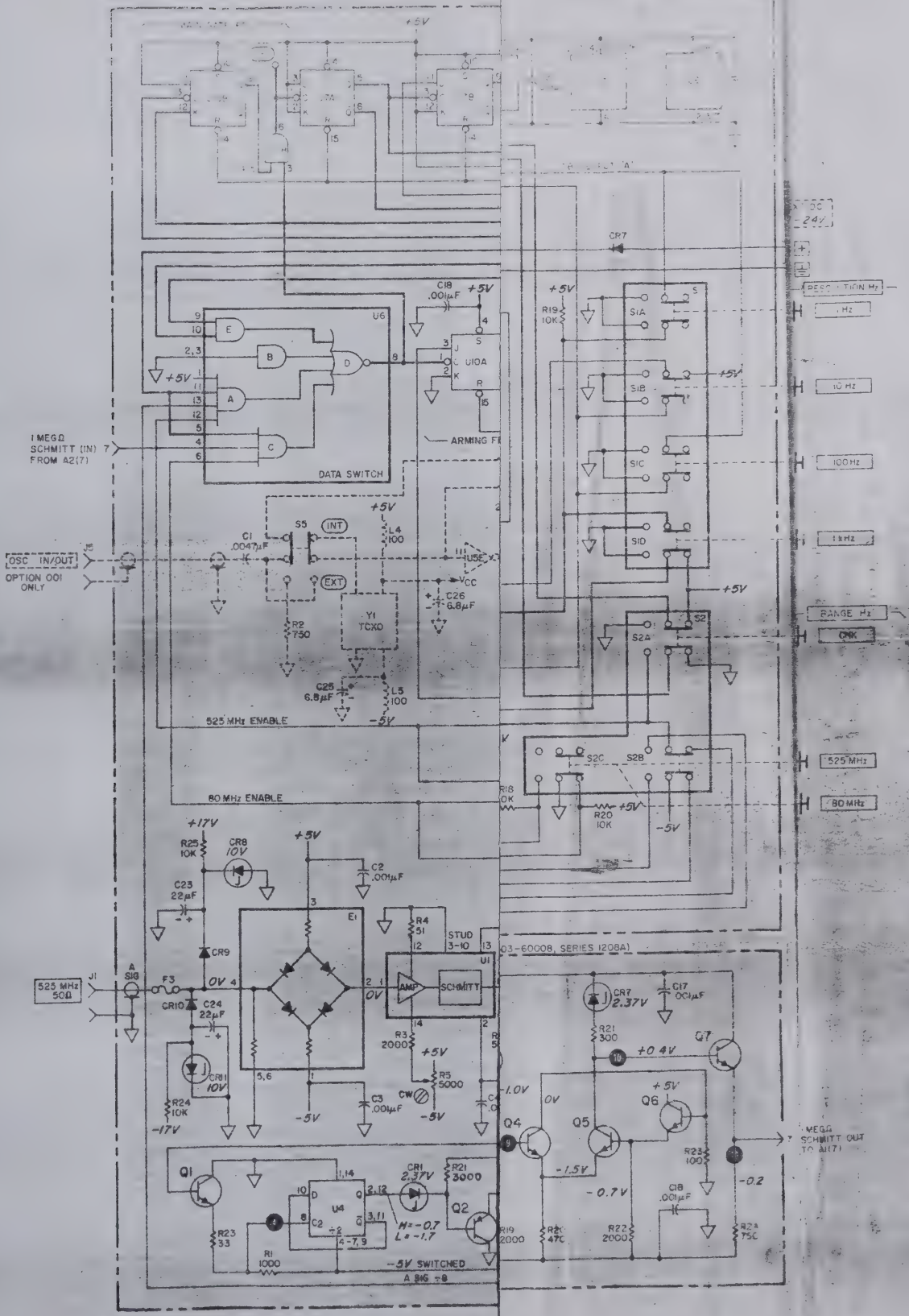


Figure 9(
A1 Logic Board Assembly, A2 AGC Amplifier Asse

A1 LOGIC BOARD ASSEMBLY (10530-60007, SERIES 1240A)

A2 AGC AMPLIFIER/SCHMITT TRIGGER ASSEMBLY (10530-60008, SERIES 1208A)

Figure 9
A1 Logic Board Assembly, A2 AGC Amplifier Asse

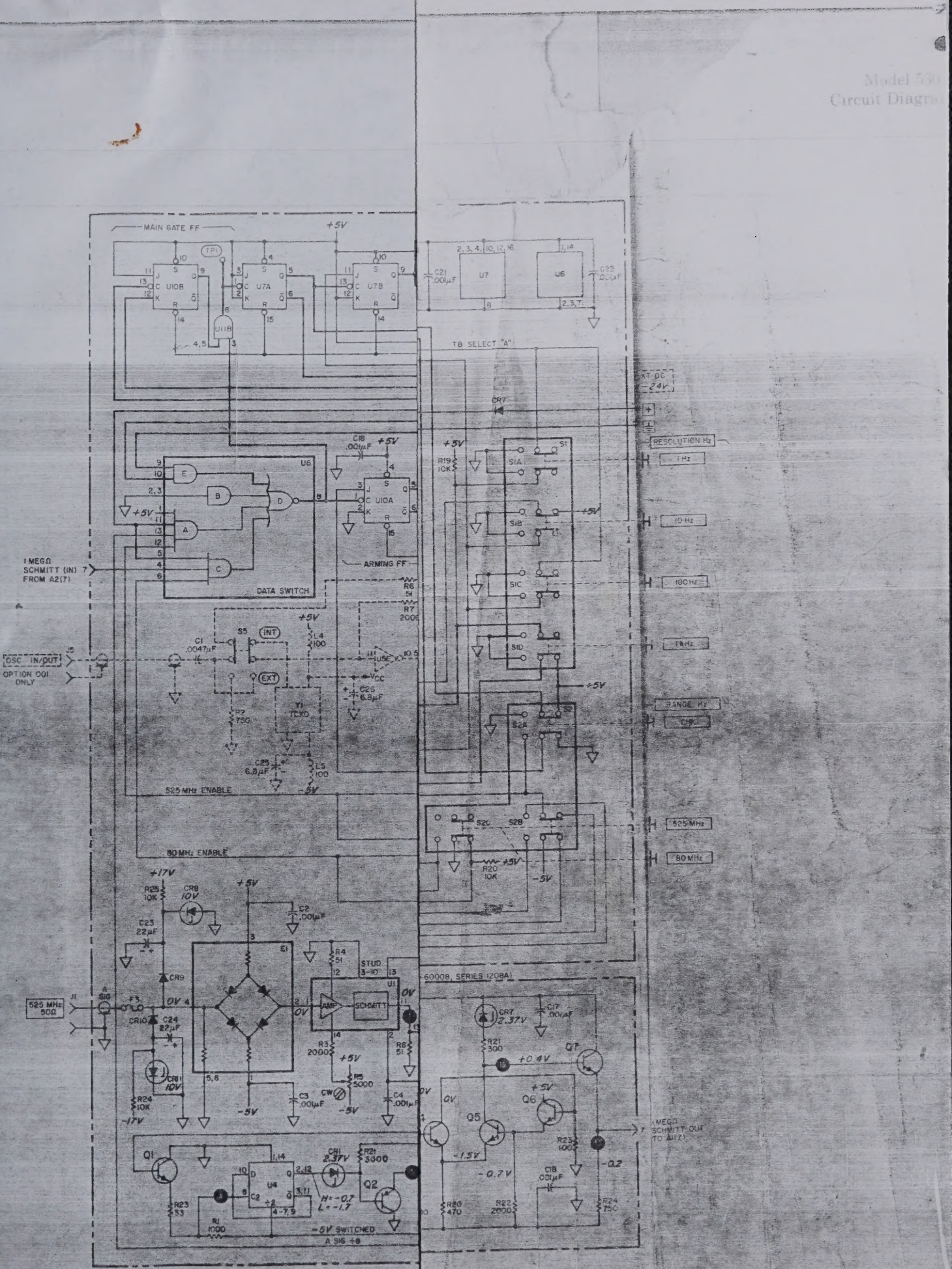


Figure 9C-
A1 Logic Board Assembly, A2 AGC Amplifier Assem

A1 LOGIC BOARD ASSEMBLY (05303-60007, SERIES 1240A) AND OPTION 001 (05303-60011, SERIES 2404)

A2 AGC AMPLIFIER/SCHMITT TRIGGER ASSEMBLY (05303-60008, SERIES 1208A)

Figure 9C
A1 Logic Board Assembly, A2 AGC Amplifier Assem